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A TEXT BOOK

OF

OPERATIVE SURGERY

AND

SURGICAL ANATOMY.

BY

PROFESSOR CLAUDE BERNARD,

AND

CH. HUETTE (DE MONTARGIS).

ILLUSTRATED BY 88 PLATES DRAWN FROM NATURE, AND ENGRAVED ON STEEL.

TRANSLATED FROM THE FRENCH, AND EDITED BY

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PREFACE.

THE present work needs but little introduction. The names of its eminent French authors are a sufficient guarantee of its excellence. The correctness and the artistic finish of the plates can hardly be surpassed, and as the French edition has met with considerable demand in both Great Britain and America, the editor believes that an English translation, revised in accordance with the progress of surgery, will prove welcome to many who are engaged in the practice of operative surgery.

Some few of the operations described in the original work have been rendered obsolete by the advancement of science and the improvement of surgical instruments and appliances, and it has been thought advisable in some instances to mention such operations only casually, and in others to withdraw them entirely from the English edition. In consequence of the changes referred to, one or two of the figures represent varieties of operations rarely performed, and portray instruments now superseded. It has not, however, been expedient to remove an entire plate for the sake of a figure, and a sufficient explanation has therefore been made in each case.

A full description of the many improvements in operative surgery which have been introduced since the publication of the French work has been added, and where more than one operation may be performed with the same object in view, special reference has been made to those operations in vogue in this country and on the continent at the present day.

ARTHUR TREHERN NORTON.

WIMPOLE STREET,
May 1*st*, 1878.

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OPERATIVE SURGERY.

PLATE I.

METHODS OF HOLDING THE BISTOURY.

There may be said to be three principal methods of holding the bistoury, each of which may be subdivided into two varieties.

First Position (Figs. 1 and 2), *Firmness and Strength.*—The handle of the bistoury is held like a table knife, with the edge of the knife turned downwards, and the index finger extended upon the back of the blade (Fig. 1); or with the edge turned upwards, and the index finger placed on the side of the blade close to its junction with the handle (Fig. 2).

Second Position (Figs. 3 and 4), *Lightness and Precision.*—The bistoury is held like a pen, with the edge turned downwards (Fig. 3), or upwards (Fig. 4).

Third Position (Figs. 5 and 6), *Nicety and Precaution.*—The bistoury is held like the bow of a violin, with the handle of the instrument held forwards, the blade backwards, and the cutting edge upwards (Fig. 5), or else with the handle backwards, the blade forwards, and the edge downwards (Fig. 6).

INCISIONS.

Incisions in the skin are made with the object of laying bare or of removing some deeper part.

They should be made sufficiently large, or the operation is rendered tedious and difficult.

Incision are *simple* and *compound.*

Simple are — (straight) or ⌣ (curvilinear).

Compound are V.L.T.H. + (crucial, or if more than one radius stellate), U (u-shaped), and ⬭ (elliptical).

Compound incisions may be sometimes avoided, when the skin is loose and plentiful, by forcibly drawing upon the margin so as to dilate the wound.

Incision are made from *without inwards*, as for the extirpation of a tumour, or from *within outwards*, as laying open a fistula.

Incisions from *without inwards.*—The skin being applied to and stretched upon the deeper parts by the left hand of the surgeon, or by assistants, the operator takes the knife in the first or second position (Figs. 1 and 3), plunges it perpendicularly at once to a proper depth, and then inclines it at an angle of 45°. On withdrawing the knife; he again raises it to the perpendicular in order to avoid terminating the incision *en queue*,—that is to say, by a cut oblique with the skin. The cut should be made by slight pressure, and by a sawing movement. When necessary to avoid with care structures situated immediately beneath

PLATE II.

CLOSURE OF WOUNDS.

The methods of closing wounds vary according to the nature of the solution of continuity, and according to the object which the surgeon has in view. When suppuration should take place the lips of the wound should be simply opposed, but when it is desired to obtain union by the first intention it is necessary that they should be adjusted very exactly, and so retained till the resulting inflammation shall have secured their union.

In some instances the divided tissues may be brought together by means of appropriate bandages or strips of adhesive plaster (Fig. 1), whilst in perhaps the majority of cases it is necessary to have recourse to an operative measure—that is, the *suture.*

SUTURES (Figs. 2, 3, 4, 5, 6).

Sutures are of three varieties.

1. The simple suture (Figs. 2 and 3), which brings together the lips of the wound edge to edge.
2. The suture *à points passés* (Fig. 5), which brings together the lips of the wound by the deep part, and to some extent surface to surface.
3. The twisted suture (Fig. 6), which brings together the lips of the wound at once by their edges and by their depths.

1. *The simple suture* is made by passing a thread by means of a needle, curved or straight, through the two lips of the wound. The two ends of the thread are now to be tied with a reef-knot and cut off short. A sufficient number of sutures must be passed to adjust the lips of the wound in their whole length. This form is called the interrupted suture (Fig. 2). If the same thread be continued through several punctures, it is called the continued suture, or the Glover's suture (Fig. 3).

2. *Suture à points passés* (Fig. 5).—This suture is commenced like the simple continued suture, the thread being passed through the two lips of the wound ; but the thread, instead of returning

across the wound, runs along its borders alternately on the right and the left sides. From its appearance it has received the name of the zigzag suture (Fig. 5).

The quill suture (Fig. 4).—A variety of the preceding. It is made by passing as many double threads as sutures required deeply through the lips of the wound. A piece of wood or quill is passed through the loops formed by the doubled threads, whilst the free ends of the threads are tied moderately tight upon a corresponding piece of wood or quill on the opposite side of the wound.

A piece of ivory or vulcanite perforated for the sutures is preferable to the quill or wood.

3. *The twisted suture* (Fig. 6) is made by passing a steel pin deeply through the two lips of the wound. The lips are then pressed together, and a thread is passed, commencing at its centre, in the form of a figure 8, around the extremities of each pin, and made to cross itself on to the pin below. The operation is completed by cutting off the extremities of the pins; and in order that they may not injure the skin a piece of plaster or lint

PLATE III.

THE SETON.

A seton is the establishment of an issue by means of threads of silk or cotton, or a piece of tape.

SETON OF THE NECK.

A vertical fold of skin on the posterior region of the neck is raised and perforated at its base by a straight bistoury held in the first position. The silk or tape, *c*, previously oiled, is then passed by means of an eyed probe, and loosely tied. A poultice may be applied to the wound, or a piece of lint smeared with simple cerate, and supported by a band around the neck. The tape may be renewed at discretion.

The seton needle (Fig. 1′) dispenses with the bistoury and the eyed probe, in that it makes the opening, and on its withdrawal brings through the silk or tape.

VACCINATION.

The upper and outer part of the arm is generally chosen for inoculation of vaccine.

There are four methods : 1. Friction ; 2. Vesication ; 3. Scarification ; 4. Puncture.

The last two only will be described.

In vaccinating by scarification a portion of the skin of the arm, about half an inch square, is scratched in all directions by the point of a needle or sharp lancet. The epidermis of an infant is extremely thin, and a very light scratch is sufficient to draw blood. Care should be taken not to make the scratches deep enough to cause the blood to run, but its appearance in the line of the scratches is to be desired. The virus is then to be passed into the scarified surface.

In vaccinating by the puncture method, an ordinary lancet, or still better a vaccine lancet and needle, (Fig. 2) is made use of. The instrument is first charged with vaccine either by dipping the point in the liquid from an open vaccine vesicle (if the vaccination is made from arm to arm), or in the humective with the preserved vaccine virus. The lancet, held in the right hand like a pen, is then presented horizontally to the surface of the skin, and its point made to penetrate to about two millimetres beneath the epidermis. After five or six seconds the instrument is withdrawn, the epidermis being slightly raised at the same time in order to cause the vaccine to enter the puncture. A small drop of blood invariably escapes, which should be pressed into the wound by the lancet to avoid the loss of the virus.

PLATE IV.

BLEEDING FROM THE ARM.

Fig. 1. Anatomy.

The skin (1) and adipose tissue covering the veins in the bend of the arm, together with the subjacent aponeurosis (2), have been removed in order to show the relation which the deep parts have towards the superficial veins.

A, Radial vein, accompanied by some filaments (*a*) of the musculo-cutaneous nerve.

B, Median cephalic vein, with a branch (*b*) of the musculo cutaneous nerve beneath it.

C, Cephalic vein formed by the union of the two preceding. Along its inner border is the muculo-cutaneous nerve (*c*).

D, Median vein and filaments of musculo cutaneous (*d*).

E, Median basilic vein crossed in front or behind by branche taking a lancet between the thumb and finger of the right hand, and supporting his hand upon the arm of the patient by means of the other fingers, he carefully punctures the dilated vein in a line obliquely, or at right angles to its course (a', a', a'').

The flow of blood may be increased by the patient grasping a stick or other material from time to time.

When the desired quantity has been obtained, the bleeding may be arrested by the application of the thumb of the left hand to the opening in the vein. The ligature around the arm being then removed a small four-fold compress is to be applied to the wound, and there retained by means of a narrow figure of 8 bandage.

The vein usually chosen for venesection is the median basilic, though any well-dilated vein in the bend of the elbow would do.

The median basilic is generally the most apparent, but it must be remembered that it lies directly over the brachial artery, being separated from it by the bicipital fascia. There is therefore, always some danger of wounding the artery.

The Editor suggests a method which he has always adopted in performing venesection at the bend of the elbow. He never uses a lancet, but a small and sharp bistoury. When the vein is well dilated, and caused to bulge by the pressure of the thumb of the left hand, the knife is taken in the right hand in the second position; the right hand is now to be supported on the side of the arm to be bled by means of the little and fourth fingers. The knife is placed with its point close up to the vein, with its cutting edge upwards, and with the back of the blade resting on the arm of the patient, and slightly pressing into the arm, so that the point of the knife is a little below the level of the vein. The knife is now pushed onwards, and it cuts through the vein at right angles, about one-quarter to one-third of its circumference. In this method there can be no danger, for the point of the knife is never directed towards the artery, and no movement on the part of the patient could make the instrument to cut.

Fig. 3. PUNCTURES AND SCARIFICATIONS.

Punctures (*a*, *a*, *a*) are made with the needle or a lancet to relieve an inflamed or œdematous part.

Scarifications (*b*, *b*, *b*) are superficial incisions made close together by means of a lancet or bistoury held in the third position.

Fig. 3′ is a scarificator in which a number of lancets (12 to 24) are set in action at the same time by means of a spring. This instrument is almost invariably used in cupping.

Fig. 4. Acupuncture.

Acupuncture is puncturing any particular tissue with a needle (Fig. 4, *a* and *b*). When the needles are connected with a galvanic battery it is termed galvano-puncture, an operation frequently performed in the treatment of nævi and aueurismal tumours.

BLEEDING FROM THE FOOT.

Fig. 3. Anatomy.

The internal saphenous vein (A) arises fram the plexus of veins (B) on the dorsum of the foot, and ascends in front of the internal malleolus (C). It is accompanied by filaments of the internal saphenous nerve (D).

Fig. 4. Operation.

PLATE V.

Fig. 1. Lancets:—1. Barley grain. 2. Oat-shaped. 3. Serpent tongue.

Fig. 2. B, Venesection of the external jugular ; A′, Arteriotomy of the temporal artery.

BLEEDING FROM THE JUGULAR (Fig. 2, B).

The external jugular vein extends from behind the angle of the lower jaw to the middle of the clavicle. Directed obliquely from before backwards, it crosses the sterno-cleido-mastoid muscle, being covered by the skin and platysma.

Operation.

The patient seated, or, still better, reclining, the circulation in the vessel is prevented by compression of the vessel a little above the clavicle. For this purpose a thick compress is pressed upon the vessel by a bandage, which is passed around the neck and beneath the opposite axilla. When the vessel is sufficiently swelled the surgeon fixes it with the left index finger, and then makes the puncture. The opening which is made about the middle of the neck should be large, and in direction at right angles to the fibres of the platysma, otherwise the blood will escape only into the cellular tissue. It often happens that the blood does not escape in a stream, but runs down the neck.

The flow of blood is arrested by removing the compress, at the same time applying the finger to the wound, to prevent the introduction of air.

The dressing consists in drawing the wound together with a piece of plaster. Sometimes a pad and circular bandage are found necessary, in order to prevent the flow of blood.

ARTERIOTOMY.

Anatomy.

A′, puncture of the temporal artery.

b′, division of the skin.

c′, Pyramidal compresses for compression of the artery.

The temporal artery, a branch of the external carotid, ascends vertically over the root of the zygomatic process of the temporal bone. After a course of about two inches upon the temple it divides into two branches—a posterior and an anterior. The latter lies upon the epicranial aponeurosis, and is covered only by the skin, a position favourable for arteriotomy.

OPERATION.

The patient being seated, or lying, the temporal artery is sought for by its pulsations, and is then fixed by the left thumb and index finger. Then with a straight bistouri, held in the third position, the operator makes a short incision across the vessel, but not completely severing it. The blood escapes, sometimes in a jet, but more often dribbles. In order to arrest it the artery is compressed on the two sides of the wound by means of the pyramidal compresses held in position by a bandage tied with the packer's knot.

⁂ It is well to completely sever the artery before attempting to arrest the hæmorrhage, as the cut extremities of the vessel will then contract.

PLATE VI.

LIGATURE OF ARTERIES.

1. *Effect of the Ligature upon Arteries.*

Fig. 1.—Arteries are composed of three tunics: *a*, external tunic—most vital, supple, and resisting; *b*, middle tunic—yellow, elastic, formed of circular fibres, possesses obscure vitality; *c*, internal tunic—slender, smooth, transparent, without vitality.

Fig. 2.—When a ligature is applied to an artery, the internal and middle tunics are torn through by the thread, and retract in such manner that the walls (*c*, *d*) of the external tunic, the only one which resists the ligature, are brought into contact by their internal face.

Fig. 3.—After the ligature of an artery, the collateral vessel (*a*) above dilates, and in the space between the ligature and the first branch above the blood stagnates, and forms a clot (*b*), which obliterates the artery after the separation of the ligature.

Figs. 4 and 5.—*Torsion* (*a*) has the same effect upon the coats of an artery as the ligature—that is, it tears through the internal and middle coats (*b*, *b*), which are pressed back above and below, whilst the external tunic (*c*) alone resists and twists to obliterate the calibre of the artery.

Fig. 6.—When the course of the blood is interrupted by a ligature or by any other circumstance, the circulation is re-established below by means of the dilatation of the anastomosis between the collateral branches above and below. Fig. 6 (Dupuytren Museum) represents an aneurism (*a*) of the popliteal artery cured by the employment of ice. The articular arteries (*b*, *b*, *b*, *b*) are considerably dilated, re-establishing the circulation in the lower part of the limb.

Fig. 7.—*a*, artery in a stump, seized on the point (*b*) of a tenaculum; *c*, *c′*, ligatures for the purpose of tying the artery.

2. *Ordinary Procedures in Ligaturing an Artery.*

In order to find an artery which it is intended to tie,—

Firstly. Determine the course of the vessel, both by anatomical knowledge and by the pulsation of the vessel.

Secondly. The skin being conveniently stretched, make an incision with a convex bistoury, held in the third position, along the course of the vessel, increasing the length of the incision according to the depth of the vessel.

This incision should comprise the skin and the cellular tissue.

Thirdly. Divide by means of the grooved director the enveloping aponeurosis, and turn aside the muscles, to seek the vessel, which is usually contained, together with its companion veins and nerves, in a common sheath.

Fourthly. Raise the sheath with dissecting forceps, and divide it with precaution sufficient only to introduce an aneurism needle.

Fifthly. Next lay aside the bistoury, and with the director and forceps free the vessel from the tissue around, taking care not to denude the vessel to too great an extent, and also to intro-

PLATE VII.

LIGATURE OF THE ULNAR AND RADIAL ARTERIES.

Fig. 1. Anatomy.

A. Brachial artery, with the median nerve *b* lying to its inner side.

c. Median basilic vein crossing the course of the brachial artery and median nerve, from which it is separated by the bicipital fascia *d*.

E. Common origin of the radial and ulnar arteries.

f. Median nerve crossing the ulnar artery near its origin.

E G. Upper part of the ulnar artery lying upon the deep flexor, covered by the pronator radii teres, flexor carpi radialis, palmaris longus, and flexor sublimis digitorum, which, being cut through, permit the artery to be seen in company with its venæ comites.

G K. Lower part of the ulnar artery more superficially situated than the upper; also accompanied by the venæ comites. It is in relation internally with the ulnar nerve and the flexor carpi ulnaris, and externally with the tendons of the superficial flexor.

L. The ulnar artery forming the superficial palmar arch.

E P. Upper part of radial artery, with its venæ comites, in relation internally with the outer border of the pronator radii teres *n*, and flexor carpi radialis *o*; externally with the supinator longus *m* which overlaps it.

P T. Lower part of the radial artery almost subcutaneous with the venæ comites, and in relation, without, with the supinator longus and the radial nerve for the middle third of its course; and within, with the tendon of the flexor carpi radialis.

Fig. 2. Operation.

Incision 1. Ligature of the ulnar artery in its upper third: division of—*a*, skin; *b*, aponeurosis; *c*, space between flexor carpi ulnaris and flexor sublimis digitorum; *d*, ulnar nerve. A, ulnar artery.

Incision 2. Ligature of ulnar artery in lower third—*a*, skin ; *b*, aponeurosis ; *c*, ulnar nerve ; *d*, tendon of superficial flexor A, artery upon the director.

Incision 3. Ligature of the radial artery in its upper third—*a*, skin ; *b*, aponeurosis ; *c*, radial nerve ; *d*, internal border of long supinator. A, radial artery.

Incision 4. Ligature of the radial artery in its lower third—*a*, skin ; *b*, aponeurosis ; *c*, radial nerve. A, artery.

Ligature of the radial artery in the lower part of the fore-arm.

Incision No. 4.

Firstly. Make an incision about 1½ inch in length on the outer side of the tendon of the flexor carpi radialis, dividing the skin and cellular tissue.

Secondly. Divide the aponeurosis upon a grooved director.

Thirdly. Seek out, isolate, and tie the vessel which lies close to the outer side of the tendon.

Ligature of the radial artery in the upper third.

Incision No. 3.

Ligature of the ulnar artery in the middle of the fore-arm.

Incision No. 1.

An incision 2½ to 3 inches long, dividing the skin and cellular tissue, is to be made in a line drawn from the trochlea to the elevation of the pisiform bone, then seek for the first inter-muscular space which becomes visible, proceeding from within outwards. Now the aponeurosis may be divided upon the director, and the flexor sublimis digitorum muscle turned aside, beneath which is the artery with its companion veins. After having isolated the vessel, it will be necessary to raise it with an aneurism needle, in consequence of the depth of the wound.

PLATE VIII.

LIGATURE OF THE BRACHIAL ARTERY.

Fig. 1.—Anatomy.

A, B. *Brachial artery.*—It extends from the lower border of the teres major to a little below the elbow joint. Situated internal to the humerus above, it descends curving from within outwards, and becomes anterior to it below. It is in relation in its upper fourth with the coraco-brachialis C, and below this with the internal border of the biceps D, which overlaps it in its two lower thirds in muscular subjects. Altogether below, it runs along the inner side of the biceps tendon, between it and the median nerve, and then courses beneath the bicipital aponeurosis *a*, which separates it from the median basilic vein *b*.

The *median nerve* E accompanies the artery in its course lying external to it above, crossing it at about the centre, and lying internal to it below.

The *ulnar and musculo-spiral nerves* are in relation with the rosis; *c*, companion vein; *d*, median nerve on the outer side of the artery E, the artery upon a director.

1. *Ligature of the brachial artery at the bend of the arm.*

Incision 1.

(1). Recognise the tendon and internal order of the biceps muscle.

(2). Make an incision 2½ inches in length along the inner border of the biceps. This incision must involve only the skin and cellular tissue, avoiding the median basilic vein, which must be pressed, according to circumstances, either inwards or outwards.

(3). Divide upon the director the aponeurosis which is here formed of the bicipital expansion.

(4). Beneath will be seen the artery accompanied by its veins, and having the nerve to its inner side; raise with the forceps the sheath of the vessels and nerve, and incise it with care to an extent sufficient to isolate the artery; raise it upon the director and ligature.

2. *Ligature of the brachial artery at the upper part of the arm.*

Incision 2.

(1). Having determined the inner border of the biceps, make an incision along 2½ inches in length, involving the skin and cellular tissue.

(2). Raise the aponeurosis upon a director.

(3). Seek the nerve nearest to the internal border of the biceps; that is, the median nerve beneath and internal to which will be found the artery.

(4). Carefully open the common sheath, having first raised it with a pair of forceps; then pushing the nerve outwards, isolate the artery, passing the director beneath it from without inwards.

PLATE IX.

LIGATURE OF THE AXILLARY ARTERY IN THE ARMPIT ITS LOWER THIRD.

Fig. 1.—Anatomy.

1. Great pectoral muscle drawn aside. 2. Small pectoral muscle. 3. Latissimus dorsi and Teres major. 4. Biceps. 5. Triceps. 6. Brachial aponeurosis.

A. *Axillary artery.*—A continuation of the subclavian artery, it commences at the lower border of the first rib, and terminates at the lower border of the Teres major. In its course it is divided into three parts by the pectoralis minor muscle. The lowest or third part of its course is in relation externally with the coraco-brachialis (*b*) muscle, and here it may be readily compressed against the humerus: internally it is covered by only the skin and cellular tissue, and its pulsation can be easily felt.

c, d, e, f. The branches of the brachial plexus closely surround the artery in the third part of its course.

c. The *musculo cutaneous nerve*, on the outer side of the vessel.

f, aponeurotic sheath of the axillary vessels; *g*, axillary artery upon the director passed from within outwards, and from below upwards.

One operation now adopted for tying the axillary artery in the third part of its course, *i.e.*, below the pectoralis minor muscle, is called Lisfranc's method. It consists of (1) finding the position of the artery by drawing a longitudinal line such as would separate the anterior third of the axilla from the two posterior thirds, or by feeling the internal border of the coraco-brachialis muscle. 2. Incising the skin and cellular tissue in the course of the vessel for a distance of 2½ inches. 3. As soon as the fasciculus of vessels and nerves comes into view, relax the parts by slightly bending the arm. 4. Next ascertain the position of the coraco-brachialis, in order to find the artery. 5. By the aid of the director press first the median nerve and internal cutaneous nerve forwards, then the ulnar and musculo-spiral backwards, the artery and vein lying in the interval between them. 6. Isolate with precaution, and pass the director from behind forwards, so as to avoid the axillary vein.

A second, and perhaps the more simple operation, for tying the axillary artery in the third part of its course is the following:—

1. Supinate the arm, and extend it nearly at right angles to the trunk. 2. Make an incision two inches and a half in length along the border of the latissimus dorsi muscle, so as to run transversely across the inner side of the arm, and terminate at the inner border of the biceps muscle. 3. Divide the deep fascia upon a director. 4. Relax the arm, and the vessels may now be detected surrounded by the nerves of the brachial plexus. In order to isolate the artery, it will be necessary to press the median nerve forwards, and the ulnar and musculo-spiral nerves backwards. The director is to be passed from behind forwards, to avoid the vein.

PLATE X.

LIGATURE OF THE AXILLARY AND SUBCLAVIAN ARTERIES.

Fig. 1.—1. The clavicle and great pectoral muscle. 2. The axillary vessels exposed. 3. Trapezius. 4. Sterno-mastoid. 5. Omo-hyoid. 6. Deltoid. 7. Small pectoral.

A. Axillary artery—its upper part covered by the pectoralis major, from which it is separated by a layer of adipose tissue containing the cephalic and other branches of vein and artery, and the external anterior thoracic nerve: *a*, supra-scapular artery running along the upper border of the clavicle.

B. The axillary vein internal to and in front of the artery.

C. The cephalic vein lies in the groove between the pectoralis major and the deltoid, crossing the artery at the upper border of the pectoralis minor, and there emptying into the axillary vein.

D. The brachial plexus external and behind the artery. The external anterior thoracic nerve may cross the artery sometimes the neck is long, and the artery can then be compressed either directly or by forcibly lowering the clavicle.

B. The subclavian vein, in front of and below the artery, from which it is separated by the insertion of the scalenus anticus, *b* (Fig. 2). The external jugular vein (*e*) crosses the artery in front to empty into the subclavian.

C. The brachial plexus of nerves are altogether external to the artery.

Fig. 3.—Operation.

Incision No. 1.—*Ligature of the axillary artery.*

a, Incision of the skin ; *b*, of the subjoined aponeurosis ; *c*, upper border of the pectoralis minor ; *e*, fibres of pectoralis major cut across ; *d*, axillary vein ; A, axillary artery upon an aneurism needle below the level of the cephalic vein.

Incision No. 2.—*Ligature of the subclavian artery external to the scalenes.*

a, Incision in the skin ; *b*, in the aponeurosis ; *c*, omo-hyoid muscle ; *d*, brachial plexus of nerves ; *e*, scalenus anticus muscle ; *f*, subclavian vein ; A, subclavian artery.

LIGATURE OF THE AXILLARY ARTERY IN THE FIRST PART OF ITS COURSE.

First Method.

In this operation the vessel is ligatured in a triangular space limited above by the clavicle, below and externally by the pectoralis minor, below and internally by the sternal portion of the pectoralis major. The shoulder lying free, the elbow slightly away from the body, and the head inclined towards the opposite side, an incision is made parallel with the clavicle, and ¾ inch to 1 inch below it, compressing the skin and cellular tissue, and extending from the cellular interval between the great pectoral and the deltoid muscles as far as two finger breadths external to the sterno-clavicular articulation. The fibres of the great pectoral muscle being successively divided, the posterior sheath of the muscle comes into view. Then, to favour the separation of the lips of the wound, the shoulder may be lowered a little, and by means of the director the costo-coracoid membrane may be torn through. With the finger introduced into the wound, the small pectoral muscle is to be pushed downwards and outwards, and in the depths will be seen—1, the axillary vein inflated with blood; 2, the axillery artery external to and behind it; 3, the brachial plexus above, external and behind the artery.

In passing the ligature behind the artery, the vein must be pressed a little inwards, and the ligature passed between it and the artery.

Second method. (Chamberlayne.) One incision four inches long is made below the clavicle, and a second nearly the same length, corresponding to the cellular interval between the great pectoral and the deltoid muscles, taking care to avoid the cephalic vein. The triangular flap thus formed is turned downwards and inwards, and the artery is to be sought above the pectoralis minor, as in the preceding operation.

LIGATURE OF THE SUBCLAVIAN ARTERY.

The subclavian artery may be tied in the second or third parts of its course.

(3). The tubercle being recognised, the artery may be felt immediately behind it, and may be readily exposed by the director, after which the aneurism needle may be passed beneath the vessel, guided along the finger from before backwards, and a little from within outwards ; at the same time the finger placed above and external to the artery—that is, between it and the brachial plexus—supports the artery and prevents it from slipping. To facilitate this part of the operation, the shoulder should be lowered.

2nd, Between the two scalenes. (Dupuytren.)

This operation differs but little from the preceding. After having recognised the tubercle on the first rib, and made out the attachment of the scalenus anticus, a director is passed between the artery and the scalenus anticus, and the muscle is to be divided. The artery is now freely exposed, and may be ligatured. The objections to this operation are,—1. The point of ligature is too near the origin of large branches. 2. The phrenic nerve which runs along the scalenus, or immediately to its inner side, is exposed to danger. 3. The subclavian vein or the internal mammary artery may be wounded.

PLATE XI.

LIGATURE OF THE CAROTID, LINGUAL, AND FACIAL ARTERIES.

Figs. 1, 2, 3.—ANATOMY.

Fig. 1. *Origin of the carotid and subclavian arteries; branches of the subclavians.*

a a, Arch of the aorta; *b*, brachio-cephalic or innominate artery; *d*, *c*, right subclavian and right carotid; *e*, *f*, left subclavian and left carotid. Before passing between the scalenes (*g*), the subclavians give off the vertebral arteries *h h*; inferior thyroids and transversales humeri, perhaps also the transversales colli, either separately or from a common trunk, the thyroid axes *i i*; internal mammaries *j j*; external to the scalenes, the posterior scapular *k k*, the thoracic axis *l*—which is, however, generally given off from the first part of the axillary artery.

Fig. 2. *Relation of the arterial with the venous trunks.*

a a, Internal jugular, in front of and external to the carotids; *b b*, subclavian veins, anterior, parallel to, and a little

B. The internal jugular vein lies external to the artery, and overlaps it.

C. The pneumogastric nerve descends behind and between the artery and vein contained in the same sheath; below it passes between the subclavian artery and vein to enter the thorax. It furnishes a variable number of cardiac branches, which cross in front of the lower fourth of the artery. The sympathetic nerve is altogether behind the sheath of the vessels, and contained in loose connective tissue.

D. The internal carotid and the external carotid D′ arise by the bifurcation of the external carotid. The external carotid, lying at first internal to and then crossing outwards in front of the internal carotid, terminates at the level of the condyle of the lower jaw, where it divides into the temporal and internal maxillary arteries. At first superficial, it then dips beneath the hypoglossal nerve (H), the digastric and stylo-hyoid muscles, and the parotid gland.

E. The facial artery arises from the external carotid a little above the hyoid bone, passes beneath the digastric and stylohyoid muscles along the outer surface of the submaxillary gland, and curving upwards, gains the body of the lower jaw, then lies in the interstice which separates the masseter muscle (4) from the triangularis oris, and distributes itself upon the cheek and face.

F. The lingual artery, arising from the external carotid below the preceding, and at the level of the hyoid bone, is crossed by the hypoglossal nerve (H), and then turning beneath the hyoglossus muscle, runs to be distributed mainly in the tongue.

OPERATION.

Incision No. 1.—*Ligature of the carotid artery in the upper part.*

a, skin; *b*, cervical aponeurosis; *c*, pneumogastric nerve; *d*, sterno-mastoid muscle; A, carotid artery.

Incision No. 2.—*Ligature of the lingual artery.*

a, skin; *b*, platysma and fascia; *c*, incision of the hyo-glossus muscle; A, the lingual artery.

Incision No. 3.—*Ligature of the facial artery.*

a, skin ; *b*, platysma and fascia ; A, the facial artery.

DESCRIPTION OF THE OPERATIONS.

I. LIGATURE OF THE BRACHIO-CEPHALIC TRUNK.

This artery, commencing at the most interior part of the transverse portion of the arch of the aorta, terminates, after a course of about an inch and a half, behind the right sterno-clavicular articulation.

(1). The patient lying upon the back with the head extended, an ┘ shaped incision is to be made, of which the horizontal stroke shall run from the sterno-clavicular articulation parallel with the clavicle, and about half an inch above it, and as far outwards as the centre of the bone. The perpendicular stroke is then to be extended upwards along the inner border of the right sterno-mastoid to a distance of about three inches.

(2). Divide upon the director the sternal origin and the greater part of the clavicular origin of the right sterno-mastoid muscle, terminating a little below the cricoid cartilage; the incision will include the skin, cellular tissue, and platysma.

(2). Incise upon a director the deep cervical fascia, which here unites the sterno-mastoid with the sterno-hyoid and sterno-thyroid muscles.

(3). Then flexing the head so as to relax the muscles, and at the same time separating the muscles referred to, the omo-hyoid muscle is brought into view, crossing the depths of the wound.

(4). The artery and vein being now seen enveloped in a common sheath, on which lies the descendens noni nerve, the sheath may be carefully raised with the forceps and with precaution divided sufficiently to admit the director, whilst at the same time an assistant presses on the internal jugular vein at the upper part of the wound, in order to prevent the great dilatation of the vein, which is often of serious inconvenience to the operator.

(5). There remains only to tear with the sound the cellular tissue which unites the vessels together, and so to isolate the artery, which may be now raised upon the aneurism needle, passing the instrument from without inwards.

2. *Ligature at the lower part.*

(1). Make an incision 2½ to 3 inches in length, commencing ⅜ of an inch above the sterno-clavicular articulation, and extending upwards along the inner border of the sterno-mastoid.

(2). The skin and cellular tissue and cervical fascia being divided, the muscle is brought into view.

(3). The French advise that the sternal fasciculus should be divided; but it is sufficient to draw it aside, when the sterno-hyoid and sterno-thyroid are now seen.

(4). The latter muscles are to be drawn inwards, and the sheath of the vessels is thus exposed.

(5). The sheath is to be opened as far inwards as possible, so as to isolate the artery without injuring the vein, which has a tendency as soon as the sheath is opened to bulge in front of the artery. The director is to be passed from without inwards, so as to avoid the vein and the pneumogastric nerve, which latter lies behind and between the vessels enclosed within the sheath.

III. LIGATURE OF THE LINGUAL ARTERY (Plate XI., Fig. 4).

(1). Having recognised beneath the integument the great cornu of the hyoid bone, make an incision about 1½ inch in length parallel with the cornu, and about ½ inch above it, including the skin, cellular tissue, and platysma myoides.

(2). This incision will expose the lower border of the submaxillary gland, which must be raised upward in order to see the shining tendon of the digastric muscle.

(3). Immediately below this is the hypoglossal nerve, and about $\frac{1}{10}$ of an inch below this nerve the hyoglossus muscle must be divided transversely, to come exactly upon the line of the artery. The vessel may be now easily ligatured, as it is not in contact with any vein or nerve.

IV. LIGATURE OF THE FACIAL ARTERY AS IT PASSES OVER THE BORDER OF THE LOWER JAW (Plate XI., Fig. 4).

(1). Request the patient to firmly close the jaw. In this way the anterior margin of the masseter muscle may be clearly

PLATE XII.

LIGATURE OF THE RADIAL ARTERY AND DORSAL ARTERY OF THE FOOT.

Fig. 1. Anatomy of the Radial Artery on the Dorsal Surface of the Carpus.

1. Post annular ligament of the carpus.
2. Extensor ossis metacarpi pollicis.
3. Extensor primi internodii pollicis.
4. Extensor secundi internodii pollicis.

A. The radial artery turning around the radio-carpal articulation passes beneath the extensor ossis metacarpi and extensor primi internodii pollicis (2 and 3), and then obliquely beneath the extensor secundi internodii pollicis to penetrate between the two heads of the abductor indicis, and thus gains the palm of the hand, where it ultimately forms the deep palmar arch. In this part of its course it is in relation with venous branches, and some nerve filaments from the radial nerve, covered only by the general aponeurosis and the integument.

Fig. 2.—Operation.

a, Incision in the intergument ; *b*, the aponeurosis ; A, the radial artery.

Fig. 3.—Anatomy of the Dorsal Artery of the Foot.

1. Dorsal annular ligament. 2. Tendon of the extensor proprius pollicis. 3. The common extensor of the toes. 4. Internal tendon of the extensor brevis digitorum.

A. The dorsal artery, a continuation of the anterior tibial artery, commences beneath the annular ligament of the tarsus (1), and extends from the middle of the intermalleolar space to the proximal extremity of the first interosseous space, where it penetrates the first dorsal interosseous muscle to reach the sole of the foot, and there anastomoses with the plantar arch. Covered by the aponeurotic layer which binds it upon the tarsus, and by the general aponeurosis and the integument, the dorsal artery descends upon the instep, accompanied by two satellite veins, and by the tibial nerve (*b*) internal to it. It courses along the outer side of the tendon of the extensor proprius pollicis (2), an important relation which can be made out by extending the great toe ; and external to it runs the inner head of the extensor brevis digitorum (4), which in muscular subjects somewhat overlaps it.

Fig. 4.—OPERATION.

a, Incision in the skin ; *b*, the aponeurosis ; A, the dorsal artery.

STEPS OF THE OPERATION.

Ligature of the radial artery on the dorsal surface of the carpus.

(1). By forced extension of the thumb determine beneath the skin the projection of the extensor secundi internodii.

(2). Make an incision about one inch in length, internal, and parallel to this tendon, the middle of the incision corresponding to the summit of the first intermetacarpal space.

(3). Divide the aponeurosis.

(4). beneath the aponeurosis, in the angle formed at the summit of the first intermetacarpal space, will be found the radial artery, accompanied by two veins.

(5). Disengage it from the veins with the point of the director

PLATE XIII.

LIGATURE OF THE ANTERIOR TIBIAL ARTERY.

FIG. 1.—ANATOMY.

1. Patella. 2. External malleolus. 3. External aponeurosis of the leg. 4 and 5. Tibialis anticus and extensor communis digitorum turned aside, and thus exposing the vessels deeply situated in the intermuscular space. (6). Peroneal muscles divided. 7. The fibula.

A. The anterior tibial artery, the external and anterior branch of the bifurcation of the popliteal, arises beneath the fibrous arch of the soleus and terminates beneath the anterior annular ligament, when it becomes the dorsal artery of the foot. Its direction from above downwards, and somewhat obliquely from behind forwards, would be represented by a line drawn from the inner part of the head of the fibula to the centre of the tibio-tarsal articulation. This artery pierces the interosseous ligament from behind forwards at the level of the upper fourth of the leg, and descends nearly two-thirds of its length upon the ligament; below it lies upon the outer surface of the tibia turning to reach the front of the lower extremity of that bone. To its inner side lies the tibialis anticus (4) and the bone; to its outer side, the extensor communis digitorum on the upper third, and the extensor proprius pollicis in the lower two-thirds, the tendon of the latter muscle crossing it below from without inwards. To the outer side of this tendon, and in the same space with it, the artery passes beneath the annular ligament.

The extensor muscles and the tibialis anticus, between which lies the artery, are intimately united and bound down by the aponeurosis (3), a disposition which conceals their partition and renders their separation difficult.

B, B. The venæ comites accompany the artery in its whole length.

C. The anterior tibial nerve, at first external to the artery, crosses in front of it at the lower fourth, and becomes internal to it beneath the ligament.

A'. The peroneal artery, a branch of the posterior tibial, descends vertically along the posterior aspect of the fibula as far as the lower tibio-fibular articulation, being covered above by the soleus, then lying between the flexor longus pollicis and the tibialis porticus (9), and below upon the interosseous ligament.

FIG. 2.—OPERATION.

Incision No. 1.—*Ligature of the anterior tibial at its lower part.*

a, The skin ; *b*, the aponeurosis ; *c*, tibialis anticus muscle ; *d*, extensor proprius pollicis ; *e*, anterior tibial nerve ; A, the artery raised upon a Deschamps' needle.

Incision No. 2.—*Ligature of the anterior tibial in its upper part.*

a, The skin ; *b*, the aponeurosis ; *c*, extensor communis digitorium ; *d*, tibialis anticus ; *e*, anterior tibial vein ; A, the artery.

Incision No. 3.—*Ligature of the peroneal artery in its lower part.*

II. LIGATURE OF THE UPPER PART OF THE ANTERIOR TIBIAL ARTERY.

(1). At rather more than an inch external to the crest of the tibia, and in the course of a line which would extend from the head of the fibula to the centre of the ankle joint make an incision three inches and half in length, dividing the skin and cellular tissue.

(2). Divide the aponeurosis upon the director, and if difficult to find the intermuscular space this fascia may be divided crucially.

(3). The intermuscular space being seen or recognized by means of the finger on the outer side of the tibialis anticus, the muscles are to be freely separated by the finger, and the vessel will be detected lying upon the interosseous ligament and accompanied by the anterior tibial nerve to its outer and front part, and the two companion veins surrounding it.

(4). Isolate the artery and ligature with the aid of a rectangular aneurism needle.

III. LIGATURE OF THE PERONEAL ARTERY.

(1). Recognize the outer border of the fibula, then half an inch behind, and parallel to it, make an incision about three inches in length, dividing the skin and cellular tissue.

(2). Divide the aponeurosis to the same extent on a director.

(3). Recognize, and then push inwards, the external border of the soleus muscle, which often overlaps the fibula. Next starting from the border of the bone, which is now uncovered, cut through a layer of fascia which covers the flexor longus pollicis, and then separate the muscle from its attachment to the fibula ; turn the muscle inwards, and the artery will be found lying upon the bone, and gradually approaching the interosseous ligament as it descends.

PLATE XIV.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

Fig. 1.—ANATOMY.

1. The patella. 2. Internal malleolus. 3. Internal surface of the tibia. 4. Internal aponeurosis. 5. Soleus muscle drawn backwards.

A. The posterior tibial artery commencing at the bifurcation of the popliteal terminates beneath the internal annular ligament, where it divides into the internal and external plantar. Its direction would be represented by a line drawn obliquely from the middle of the ham to a point behind the malleolus.

In its *upper third* the artery is deeply situated, lying upon the tibialis posticus (7), and covered by the deep aponeurosis, the soleus (5), and gastroenemius (9).

In its *middle third* it approaches nearer to the surface, descending parallel to the internal border of the tibia, separated from the bone by the common flexor of the toes (8), and covered by the *d*, the common flexor ; *e*, the posterior tibial nerve ; A, the artery.

Incision No. 3.—*Ligature of the upper third of the posterior tibial artery.*

a, The skin ; *b*, the aponeurosis ; *c*, the gastrocnemius drawn back by a retractor ; *d*, an incision made through those fibres of the soleus attached to the inner border of the tibia ; A, the artery.

STAGES OF THE OPERATION.

1. *Ligature of the posterior tibial artery in the lower part or behind the malleolus.*

(1). At one-third of a inch behind the posterior border of the internal malleolus make a semilunar incision in the integument nearly two inches in length, the concavity embracing the malleolus.

(2). Divide the aponeurosis upon a director, carefully avoiding the synovial grooves on the posterior part of the malleolus.

(3). Beneath the aponeurosis and in front of the nerve, the artery is to be found between two companion veins.

2. *Ligature of the middle third of the posterior tibial artery.*

(1). At three-quarters of an inch behind the internal border of the tibia make an incision two inches and a half in length in the skin and cellular tissue.

(2). Divide the aponeurosis, and draw the border of the soleus muscle outwards.

(3). Incise the deep aponeurosis upon a director, and immediately beneath it will be seen the artery with its two veins.

3. *Ligature of the upper third of the posterior tibial artery.*

(1). At about one inch behind the internal border of the tibia make a longitudinal incision three and a half to four inches in length through the skin, cellular tissue and aponeurosis.

(2). By means of the index finger within the wound separate and turn outwards the internal border of the gastrocnemius.

(3). Next detach the fibres of the soleus arising from the internal border of the tibia and turn this muscle outward.

(4). Whilst these muscles are held backwards and outwards by a retractor, divide upon a director the deep aponeurotic fascia, beneath which can be seen the vessels.

(5). Isolate the artery, and pass the ligature with either a Cooper's or a Deschamps' needle.

Mannec's Method.

Instead of detaching the soleus muscle from the tibia, this author advises the division of this muscle layer by layer in its whole thickness, penetrating the posterior surface of the muscle at about three-quarters of an inch from the internal border of the tibia. The knife soon comes upon a thick pearly fibrous lamina upon which are inserted the fleshy fibres, the anterior aponeurosis of the muscle traversed by numerous vascular branches. On incising this aponeurosis, the deep aponeurotic fascia comes into view, beneath which lies the artery.

In performing this operation, the contractions of the muscles often impede the operator to such an extent that it becomes necessary to divide the muscle across its fibres.

PLATE XV.

LIGATURE OF THE POPLITEAL ARTERY.

Figs. 1, 2, and 3.—ANATOMY.

Fig. 1.—*Aponeurotic layer, superficial vessels and nerves.*

1—1. Popliteal aponeurosis in part removed. 2. Semimembranosus. 3. Biceps. 4. Cutaneous vessels and nerves. 5. Internal saphenous vein.

A. *External or short saphenous vein.*—It ascends for a distance vertically towards the middle of the popliteal aponeurosis, where it perforates; beneath the fascia it runs external to the popliteal nerve to enter the popliteal vein. It is accompanied by the external saphenous nerve (*b*).

C. *The popliteal or internal popliteal nerve.*—Sub-aponeurotic in the popliteal region, which it traverses vertically from above downwards to become the posterior tibial nerve; situated superficial to and a little external to the popliteal vessels, from which it is separated by a fine layer of adipose tissue, it furnishes beneath the aponeurosis many filaments to the popliteal region; from it is also given off the communicans poplitei (*b*) or external saphenous which perforates the fascia in company with the short saphenous vein.

D. *Peroneal or external popliteal nerve.*—More superficial and smaller than the preceding. It descends obliquely from within outwards, beneath the aponeurosis, to be distributed in the leg. In the popliteal space it gives off the communicans peronei, and a branch called the peroneal saphenous (*e*), which piercing the aponeurosis in a variable position, ultimately joins the external saphenous (*b*).

Fig. 2.—*Sub-aponeurotic dissection.*

The popliteal nerve is cut across, and the adipose tissue which occupies the space has been removed, leaving bare the popliteal vessels.

A. *The popliteal artery* extends from Hunter's canal to the lower border of the popliteus muscle; it is directed a little obliquely from within outwards, overlapped in its course and crossed near the centre by the popliteal vein (B), which at the lower part of the artery is somewhat internal and at the upper part external to the artery. These two vessels are covered superiorly by the belly of the semi-membranosus (1), and at the lower part by the two bellies of the gastrocnemius (2 and 3). They are bound together in their course by dense connective tissue, which renders it difficult to isolate them.

Fig. 3.—A. The popliteal artery, at first internal to the femur (1), lies below upon its posterior surface, then passing between the condyles (2 and 3) comes into contact with the tibio-femoral articulation. In its course it furnishes many branches, of which the chief are—the *superior articular* (*a b c*); *the inferior articular* (*d e*), which anastomose with the preceding in front of the knee; the *azygos articular;* and the *sural,* which are distributed to the gastrocnemius.

Fig. 4. Operation.

The popliteal artery may be ligatured either in the upper or the lower part of the popliteal space by the same operation—the only difference being that to find the vessel in the lower part it would be necessary to make an incision four inches in length, commencing one-third of an inch above the articulation, and

(4). Recognize the outer border of the semimembranosus muscle, and the popliteal nerve will be now seen coming from beneath it.

(5). Push the nerve inwards, and beneath and a little internal to it will be found the popliteal vein.

(6). Isolate the vein with caution, and also draw it cautiously inwards, when the artery will be found lying the deepest of all the structures.

(7). Carefully isolate the artery and ligature with an aneurism needle.

MARCHAL'S METHOD.

The object of this operation is to tie the popliteal artery in its lower part, but instead of arriving at it through the popliteal space, the inner side of the leg is penetrated.

The patient lies upon the back with the leg flexed and lying on its outer surface. The surgeon, standing on the outer side of the limb, makes an incision 3½ inches in length, commencing below the internal tuberosity of the tibia and carrying it downwards along the internal border of the inner head of the gastrocnemius—that is, somewhat obliquely from without inwards and from behind forwards to within a third of an inch of the internal border of the tibia.

On dividing the skin, the internal saphenous vein is to be avoided. The gastrocnemius is next to be recognised; then, on flexing the leg upon the thigh, so as to relax that muscle, the index finger is to be introduced beneath it, so as to completely separate it from the deep muscles. The artery is now readily seen, with the nerve slightly to its inner side and surrounded in its lowest part by the satellite veins which accompany the tibial arteries.

JOBERT'S METHOD.

In this operation, which is the counterpart of the preceding, the object is to tie the popliteal artery in the upper part; but instead of approaching it through the popliteal space, an incision 3½ inches in length is made, commencing immediately above the inner condyle of the femur : the dissection is carried between the vastus internus and the muscles which form the inner boundary of the popliteal space.

PLATE XVI.

LIGATURE OF THE FEMORAL ARTERY.

Fig. 1.—ANATOMY.

A. The femoral artery, a continuation of the external iliac, extends from the middle of the crural arch (1) to the end of Hunter's canal, where it becomes the popliteal. The vessel is in front of the femur in the upper part of its course, internal to it in the middle, and posterior to it in the popliteal region. In its upper fourth it is covered only by some lymphatic ganglia, the femoral aponeurosis and the skin—its superficial position allowing of its being compressed upon the body of the pubes or upon the head of the femur. Lower the sartorius muscle (*b b*) becomes its companion, covering it and also crossing it in such manner that the vessel corresponds to its internal border on the upper part of its extent, and almost to its external border in Hunter's canal.

C. The femoral vein accompanies the artery, lying internal to it above, posterior to it in the chief part of its extent, and a little external to it below. These two vessels, united together by a very dense cellular tissue in their two lower thirds, are in addi-

d, internal saphenous nerve; *e*, tendinous sheath of the femoral vessels at Hunter's canal; A, the artery.

Incision No. 2.—*Ligature of the femoral artery in its upper third.*

a, the skin and cellular tissue; *b*, aponeurosis; *c*, sheath of the femoral vessels; *d*, femoral vein; *e*, saphenous nerve; *f*, internal border of the sartorius; A, the artery.

STAGES OF THE OPERATION.

Ligature of the femoral artery in Hunter's canal.

(See Fig. 2, Incision 1).

The course of the artery is represented by a line drawn from the centre of the crural arch to the internal condyle of the femur.

(1). The thigh being partly flexed and turned outwards, make an incision through the skin and cellular tissue three inches long in the direction of the line referred to, and commencing rather below the middle of the thigh, so that the centre of the incision shall correspond to the union of the lower with the middle third of the thigh.

If preferred, the outer margin of the sartorius may be chosen for the line of the incision instead of the line representing the course of the artery.

In order to define the precise course of the sartorius muscle, it is well to make the patient put that muscle into action before being placed under the influence of the anæsthetic; and if the operator so desire he may mark the border with ink.

(2). Divide the aponeurosis (*b*) on the director a distance of half an inch internal to the external border of the sartorius.

(3). Draw the sartorius inwards, and then with the index finger seek the interval between the adductor magnus and the vastus internus; in this way the finger is brought against the entrance to Hunter's canal.

(4). With the greatest care the wall of Hunter's canal may be divided upon a director, and the artery may now be seen with the vein behind and external, the internal saphenous nerve above and crossing it.

(5). With the point of the director carefully separate a sufficient space around the artery within the dense cellular tissue which unites the vessels together, and pass the ligature from behind forwards.

Ligature of the femoral artery in the middle of the thigh.

HUNTER'S OPERATION.

Fig. 2, Incision 2.

The limb being placed as in the preceding operation—

(1). Make an incision through the skin and cellular tissue three inches long, in the middle third of the thigh and in the direction of the artery recognised by the representative line or along the inner border of the sartorius muscle. In this incision the saphenous vein is to be avoided.

(2). Incise the aponeurosis upon the director.

(3). Draw the sartorius muscle outwards, in order to expose the sheath of the vessels which is subjacent.

(4). With the point of the director in the right hand and the forceps in the left, make a small opening in the sheath over the position occupied by the artery.

(5). With the director isolate the artery carefully from the tissue around it, and pass the ligature from within outwards.

PLATE XVII.

LIGATURE OF THE FEMORAL ARTERY IMMEDIATELY BELOW THE CRURAL ARCH; OF THE ILIAC AND EPIGASTRIC ARTERIES.

FIGS. 1 and 2.—ANATOMY.

1—1. The cut fibres of the external and internal oblique and transversalis muscles. 2. Peritoneum and fascia transversalis; the fascia transversalis ensheathing the spermatic cord by an infundibuliform prolongation (3). 5. The crural arch. 6. The fascia lata, the part about the saphenous opening removed, to show the vessels.

A, Femoral artery; B, femoral vein an aponeurotic layer or septum separating the vein from the artery. C, Internal saphenous vein. D, lymphatic vessels and ganglia.

A′. The epigastric artery arises from the inner side of the external iliac, immediately above the crural arch. It passes beneath the vas deferens, or in the female the round ligament, and curves upwards and inwards, between the peritoneum and the fascia transversalis, to reach the deeper surface of the rectus muscle. It is accompanied by two veins.

Fig. 2.

1. Section of the abdominal muscles cut parallel to the crest of the ilium. 2. Anterior superior spine of the ilium. 3. Fascia lata. 4. Psoas muscle. 5. Iliacus muscle.

A, Aorta. B, Right common iliac.

This artery commences at the bifurcation of the aorta, at the lower border of the fourth lumber vertebra, and descends obliquely outwards as far as the sacro-iliac symphysis, where it divides into external and internal iliac (C and D).

The external iliac artery (C), continuing the course of the common iliac as far as the crural arch forms with that vessel a single trunk, almost rectilinear, applied above to the vertebral column and below to the psoas muscle (4). Before passing under the crural arch the external iliac gives origin to the deep circumflex iliac (c), and the deep epigastric arteries (c′).

The internal iliac artery (D) forms an acute angle with the preceding, and plunges into the pelvic cavity, where it at once divides into many branches.

The common iliac arteries are crossed at the level of the sacro-iliac symphysis by the ureter (*e*), and the spermatic veins (*d*).

E, The common iliac veins passing behind the right common iliac artery unite to form the vena cava inferior.

G, The anterior crural nerve. H, Lymphatic glands and vessels.

Fig. 3.—OPERATION.

a, the skin ; *b*, *c*, *d*, incisions in the aponeurosis and in the muscles forming the wall of the abdomen ; *e*, the peritoneum separated (but not incised) and raised upwards from the external iliac vein ; A, the external iliac artery upon a Deschamps' needle.

STAGES OF THE OPERATIONS.

Ligature of the common femoral artery.

(1). Recognise the position of the artery by its pulsations at a point a little internal to the centre of Poupart's ligament.

(3). With the index finger separate the cellular tissue on the outer side of the artery, keeping the finger also rather beneath the vessel.

(4). By means of the finger the external circumflex artery will be felt, and by following this inwards the deep femoral artery can be detected.

(5). Isolate it from the surrounding tissue and its vein by the point of the director.

It is rarely necessary to ligature this vessel; but should occasion arise, it should be tied some distance below the origin of the circumflex vessels, otherwise there will be danger of secondary hæmorrhage.

Ligature of the external iliac artery.

The patient lying upon the back with the muscles of the abdomen relaxed—

(1). Make a curved incision three inches and a half in length, and one inch above Poupart's ligament, commencing from a point half an inch external to the external abdominal ring, and terminating at a point on a level with the anterior superior spine of the ilium, but nearly two inches internal to it. In cutting through the skin and cellular tissue some small vessels will be cut, which, if necessary, may be tied before proceeding with the operation.

(2). Incise upon a grooved director the muscular fibres and tendinous aponeurosis of the external oblique.

(3). In like manner cut through the internal oblique and transversalis muscles.

(4). By the index finger detach the fascia transversalis as low as Poupart's ligament.

(5). It is possible that it may be necessary to cut this fascia on the director. If so, the greatest care must be taken not to enter the peritoneum, but it is better when practicable, instead of cutting the transversalis fascia, to push on steadily and carefully with the finger, so as to raise the transversalis fascia with the peritoneum away from the vessels.

(6). Next measure the point at which the artery should be found a little internal to the centre of Poupart's ligament, and with the index finger pressed down upon that point determine the pulsation of the vessel.

(7). Next, whilst the wound is kept open by the fingers of an assistant, or by a soft retractor,—the sheath of the vessels being now seen, and the artery being the external of the two,—with the point of the director prick open the sheath, which is here thin, and pass the director carefully on each side of it, so as to prepare the way for the needle of Deschamps, which must be passed from within outwards.

Ligature of the epigastric artery.

This artery may be wounded in an operation for strangulated hernia, or by accident. If the artery is wounded close to its origin, it would be necessary to ligature the external iliac artery as well. The same method as the preceding must be adopted, only on arriving at the spermatic cord that structure must be drawn outwards, to see the position of the internal abdominal ring. At this point—that is, in contact with the inner side of the spermatic cord, and immediately behind the transversalis fascia—is the artery.

to avoid injuring the peritoneum, and incise it upon the director, or tear it carefully with the finger.

(4). Now with the finger cautiously detach the peritoneum from the structures behind it sufficiently to expose the vessel in question.

(5). Isolate the vessel with the point of the director.

(6). With a rectangular aneurism needle pass the ligature behind the vessel about its centre.

The common iliac artery may be also ligatured by Stevens' method for ligaturing the internal iliac artery.

Ligature of the internal iliac artery—Stevens' method.

(1). Make an incision through the skin and cellular tissue five inches in length, external to the deep epigastric artery and parallel with it.

(2). Divide successively upon a director the abdominal muscles.

(3). By means of the finger carefully separate the peritoneum from the psoas and iliacus muscles, and from the brim of the pelvis, as far as the level of the bifurcation of the common iliac.

(4). Cautiously isolate the vessel with the index finger, and pass the ligature by means of the common aneurism needle.

Ligature of the gluteal artery.

The patient lying on the belly—

(1). Ascertain the position of the summit of the great trochanter, and also of the posterior superior iliac spine.

(2). Make an incision four inches in length, commencing at a point an inch and a quarter below the posterior superior iliac spine, and an inch and a quarter external to the sacrum, descending obliquely towards the summit of the great trochanter.

(3). Having cut through the skin and cellular tissue, and the fibres of the great gluteal muscle, the artery will be found situated immediately below the superior border of the great sciatic notch.

(4). Press aside the pyriformis and middle gluteal muscles, which by their proximity conceal the vessel, then isolate the vessel and ligature it.

AMPUTATIONS.

When it is required to amputate a limb or a part of a limb by disarticulation, it is necessary (1) to discover the precise spot of articulation; (2) to penetrate it, in cutting through the structures which unite the bones; (3) so to manage the soft parts that the stump shall be sufficiently covered.

1. *Rules for recognizing the line of articulation.*

Nearly all the extremities of bones which enter into the formation of joints are provided with tuberosities prominent beneath the skin. These tuberosities, more or less close to the joint, occupy such positions as to serve as sure guides to the surgeon in defining the articulation.

(1). Seek first that which is the most distinct, as the smaller prominences are then more easily recognized.

(2). With this view place the limb in a convenient position, and if necessary exercise movements in order to make the osseous prominences more distinct, or to render visible and apfinger the two extremities of the articular diameter—thus the line which the knife must take will be defined.

(2). In penetrating a joint anteriorly, it should be extended; and if, on the contrary, it is to be penetrated from behind, it should be partly flexed, in order to increase the articular interspace.

(3). Always commence by dividing the principal ligaments which hold the bones together; the lateral and dorsal being divided, the knife can usually be insinuated between the articular surfaces; but if the articulation be dovetailed, as the tarso-metatarsal there may exist special means of attachment of the interosseous ligaments, which it will be necessary first to divide with the point of the knife.

(4). When the articulation is well opened, it will generally suffice to pull aside the articular surfaces by moderate traction. If the articulation is closely joined, it will be necessary to luxate it by force, care being taken to avoid undue injury to the parts; then, if there should exist by chance ossified ligaments which do not yield to the knife, it will be necessary to separate them by the saw.

(5). When a joint is penetrated, the heel and the point of the knife ought to proceed parallel upon the same line; and if when passing beyond the articular surfaces to leave the joint the surgeon fears to perforate the integument destined for the formation of the flap, it will suffice to separate them by the thumb and finger, and by gentle traction.

3. *Methods of operating.*

All amputations of the limbs may be arranged under three heads:

(1). *The circular operation.*—In this case all the parts are divided in a circular manner, and the section is covered solely by the skin, which has been previously drawn up like a sleeve before making the incision.

(2). *The oval or oblique operation.*—This form is usually adopted in the removal of the digits, and consists of an elliptical incision around a part or joint which results when the amputation is completed in a wound the form of which is oval.

(3). *Flap operation.*—In this case one or more flaps are cut of dimensions calculated to cover the surface of the wound without tension.

RULES FOR MAKING THE FLAPS.

(1). In cases where it is difficult to control hæmorrhage—for instance, amputation at the shoulder joint,—the less important flap or flaps should be first made, and when the disarticulation is completed the flap which will contain the large vessels may be cut.

(2). In making a flap outwards, care should be taken not to terminate it in a point. The cutting should therefore be effected by the whole length of the blade, carried with a slight sawing motion, and in a line obliquely from the point of puncture to the point at which it has been previously determined to terminate the flap. By this means the extremity of the flap will be rounded. Should the knife be carried deeply and parallel with the bone, the flap will contain an excess of the muscular tissues; and, on the contrary, should the knife be carried too superficially, approaching a parallel to the skin, the flap will terminate in a point.

PLATE XVIII.

DISARTICULATION OF TWO LAST PHALANGES OF THE FINGERS AND OF AN ENTIRE FINGER.

ANATOMY.

Fig. 1.—*Palmar view of the bones of a finger.*

a, Inferior extremity of the metacarpal bone ; *b*, shaft of the first phalanx ; *c*, head of the first phalanx ; *d*, second phalanx ; *e*, third or ungual phalanx.

The phalangeal articulations are true ginglymoid, permitting of only flexion and extension.

Each phalanx presents near the joint prominences of some size on the dorsal aspect (Fig. 2, *e*), and on the palmar aspect (Fig. 1, *c c*). To the two lateral ligaments is due the solidity of the joint. The extensor tendon behind and a loose anterior ligament, complete the means of union of a phalangeal articulation. The direction of the articular interspace is neally transverse, and corresponds to the cutaneous fold on the palmer surface, for the articulation of the first with the second phalanx, and to a line one-eighth of an inch below the fold for the articulation of the second with the third phalanx.

Fig. 2.—*Section of the bones of a finger, to show the relations of the joints with the folds of the skin.*

a, Lower extremity of the metacarpal bone ; *b b*, line of metacarpo-phalangeal articulation, situated at an inch or rather more above the level of the digital commissure ; *d d*, first phalangeal articulation at the level of the palmar fold of the skin ; *f f*, second phalangeal articulation about one-eighth of an inch below the palmar fold of the skin.

Fig. 3.—*Union of the phalanges with each other and with the metaoarpal bone.*

a, *a*, *a*, Dorsal surface of the joints ; *b*, tendon of the flexor sublimis ; *c*, tendon of the deep flexor.

Fig. 4.—*Bones of a finger flexed, to show the relation of the articulating surfaces during flexion.*

OPERATIONS.

Fig. 5.—*Disarticulation of the second phalanx by dorsal incision.*

First stage.—The joint is entered at once by the blade of the knife.

Fig. 6.—*Same operation.*

Second stage.—After having traversed the articulation the knife is turned beneath the bone, and brought forwards in order to cut a palmar flap.

Fig. 7.—*Operation completed.*

Flap applied to the stump by adhesive plaster. Instead, however, of employing plaster, it is better to adjust the edges of the skin by wire sutures.

Fig. 8.—*Modification of preceding method.*

(See description of the operations.)

Fig. 9.—*Disarticulation of the second phalanx by the palmar surface.*

a, *b*, *c*, form to be given to the palmar flap.

Fig. 11.—*Same operation.*

Second stage.—The flap *a* being raised, the joint is entered by the blade of the knife.

Fig. 10.—*Same operation completed.*

Fig. 12.—*Disarticulation of the entire finger.*

dorsal flap are no longer employed, the single flaps being generally substituted.

Disarticulation by the dorsal surface.

The hand being pronated, an assistant holds the sound fingers as far as possible from that to be operated upon. The surgeon seizes the phalanx with the thumb and finger of the left hand and flexes it to an angle of 45°; then, with the knife held in the first position (plate I, fig. 1), he attacks the articulation by the dorsal surface, cutting perpendicularly one-tenth of an inch below the upper margin of the inclined plane formed by the semi-flexion of the phalanx—or, if this sign fails, incising at the level of the palmar fold for the second phalangeal articulation, or one-eighth of an inch below if the terminal phalangeal articulation. At the same time that the capsule of the joint is opened, the knife, guided from heel to point, should cut from left to right a small semicircular flap. Next, the edge of the knife should be carried right and left of the articulation, to divide the lateral ligaments entering the joint easily with the whole blade (Fig. 6). At this moment the operator seizes the phalanx by the sides, and the knife, after having turned around the base of the phalanx, is carried forwards beneath the bone, with its surfaces flat, to the extent of about one-third of an inch, in order to cut a small semicircular flap sufficiently large to cover the stump (Fig. 7). In cutting through the ligaments the operator should avoid cutting the base of the palmar flap.

Disarticulation from the palmar surface.

The hand being supinated, an assistant holds the sound fingers flexed. The surgeon seizes the phalanx with the thumb and index finger of his left hand, in such a manner that the thumb is applied to the end of the palmar surface, and the second phalanx of his index finger upon the dorsal surface of the articulation to be opened; then the operator, holding in the right hand a sharp pointed knife in the first position (plate I, fig. 2), with the blade flat, thrusts through the point of the knife one-eighth of an inch in front of the palmar fold for amputation at the third phalanx, and at the level of the fold for the second phalanx (Fig. 9). The knife now, by pressing and sawing, is carried along the anterior surface of the bone to the extent of about half an inch, after which the edge of the blade is raised, to cut a semilunar flap (Fig. 10). The flap being raised by the assistant, the edge of the knife is next applied perpendicularly, to divide with a single cut the anterior and lateral ligaments, when the instrument traverses the joint and removes the phalanx without making a dorsal flap. If, however, fear should be entertained lest the tissues should retract too greatly, the section of the skin on the dorsal surface might be made at one-tenth of an inch or more below the level of the articulation.

After the above descriptions, it is easy to understand how the surgeon could make, if desirable, two equal flaps, a palmar and a dorsal, or one flap shorter than the other, or even two lateral flaps.

The rules for the disarticulation of the third phalanx of a finger are applicable to the disarticulation of the second phalanx of the thumb

II. Disarticulation of an Entire Finger (Fig. 12.)

Method by Two Lateral Flaps.

The hand being pronated, and the neighbouring fingers separated by an assistant, the surgeon ascertains precisely the level of the metacarpo-phalangeal articulation before commencing the operation. To such end he must recollect that the joint

Second stage.—In the preceding stage a single lateral semi-circular flap has been cut, which should be detached from the phalanx. Then the knife, still held in the first position, is to be turned with the blade flat upon the phalanx, and the handle at right angles to the hand of the patient, and carried by sawing and light pressure along the bone towards the articulation, until an obstacle is met with. The obstacle referred to is the base of the phalanx, around which the knife is to be carried carefully and without any jerking movement, when it will be made to penetrate the joint with facility.

Third stage.—The articulation is to be traversed by the narrow part of the blade, near to the point—to simplify which ome traction may be made upon the finger in order to enlarges the cavity of the articulation.

The joint being completely separated, the knife is then carried around the base of the phalanx and brought back along the opposite side of the phalanx as far as the digital commissure, and thus by a single cut the second flap is formed. When the double-flap operation is applied to the index or little finger there is only one flap in relation with the digital commissure. The other flap is more liable to retract; it is therefore convenient to give it a greater extent.

OVAL OPERATION.

The surgeon having seized the finger, as in the preceding operation, makes with the heel of the knife an oblique incision, commencing on the dorsal surface at one-fourth of an inch beyond the articulation, and extending it as far as the digital commissure; he then raises the hand, and with the finger in extension continues the incision along the palmar groove which separates the finger from the hand; once arrived at the digital commissure on the opposite side, he again lowers the hand, and flexes the finger, to make the incision join the other extremity one-sixth of an inch below the point at which it was commenced. Then each lip of the wound is to be lightly dissected, and the joint attacked by the dorsal surface—first dividing the extensor tendon and then the lateral ligaments. The finger is now to be still further flexed and drawn upon, so as to loosen the joint, and at the same time the flexor tendons divided, as well as the surrounding soft parts.

The oval method is rarely used for disarticulation of the fingers.

PLATE XIX.

DISARTICULATION OF THE FOUR FINGERS AND OF THE FIRST AND FIFTH METACARPAL BONES.

OPERATIONS.

Fig. 1.—*Disarticulation of the four fingers.*

a b' c, Dorsal incision in front of the heads of the metacarpal bones. The knife is passed under the phalanges, to cut a palmar flap.

Fig. 2.—*a b c*, form of the palmar flap.

Fig. 3.—*Disarticulation of the metacarpal bone of the thumb.*

Modification of the oval method; *a b c*, form of incision (called racket incision).

Fig. 4.—The thumb being drawn across the palm of the hand, the disarticulation of the base (*a*) of its metacarpal bone is accomplished.

Fig. 5.—*Lips of the wound adapted.*

Fig. 6.—*Disarticulation of the fifth metacarpal bone.*

Oval method modified.—*a b c*, Form and direction to be given cut from behind forwards the palmar flap, which will be limited by the groove which unites the fingers with the palm of the hand.

II. DISARTICULATION OF THE METACARPAL BONE OF THE THUMB.

OVAL METHOD.

The hand being supinated, an incision is made along the outer border of the dorsal surface of the metacarpal bone of the thumb, commencing half an inch above its articulation with the trapezium, and dividing all the tissues as far as the bone. About the middle of the metacarpal bone the incision is to be turned off towards the inner side of the first phalanx, at the level of the interdigital commissure. Then, pronating the hand, the incision is to be carried around the extremity of the metacarpal bone upwards, to join the original incision on the dorsal surface at the middle of the metacarpal bone. Next, the muscles are to be detached on each side of the bone, and after conveniently dissecting back the skin, the carpo-metacarpal joint can be entered by its dorsal surface. Next, luxating outwards the metacarpal bone, the disarticulation is accomplished by dividing the soft tissues which still retain the bone.

III. DISARTICULATION OF THE METACARPAL BONE OF THE LITTLE FINGER.

OVAL METHOD.

The hand being forcibly pronated, an incision is commenced at about half an inch above the carpo-metacarpal articulation, and carried downwards in a straight line as far as the inner border of the first phalanx of the little finger, at the level of the digito-palmar groove. The operator now raises the little finger, and following exactly the digito-palmar groove, carries the knife around the base of the little finger and again ascends to the dorsum of the metacarpal bone, there to join the first incision at its lower third. The skin and soft tissues are next detached from the bone, after which the ligaments are destroyed by the point of the knife and the disarticulation is completed.

PLATE XX.

CARPO-METACARPAL AND RADIO-CARPAL DISARTICULATION.

Anatomy.

Fig. 1.

a, lower extremity of the ulnar; *b*, lower extremity of the radius; *c*, *d*, *e*, *f*, *g*, *h*, *i*, bones of the carpus; 1, 2, 3, 4, 5, first second, third, fourth, and fifth metacarpal bones.

The *carpo-metacarpal articulation* represents a broken line, of which the two extremities are easily recognized.

Externally it corresponds to the upper extremity of the first metacarpal bone. It will be sufficient to forcibly adduct this last, in order to make the articular extremity protrude where it is received into the concavity of the trapezium (*i*) and there retained by loose ligaments.

Internally the carpo-metacarpal articulation corresponds to the articulation of the fifth metacarpal bone with the unciform bone (*f*); the prominence of the base of this bone may be recognised beneath the integuments by running the finger along importance when the position of the styloid apophyses cannot be determined.

OPERATIONS.

Fig. 2.—*Disarticulation of all the metacarpal bones except that of the thumb.*

a, b, c, form of the palmar flap.

Fig. 3.—*Same operation.*

a, b, c, incision of the integuments on the dorsal surface—the knife penetrating the articulation.

Fig. 4.—*Radio-carpal disarticulation—circular method.*

a, b, sleeve of skin raised ; *c, c,* knife dividing the tendinous structures which surround the joint.

Fig. 5.—*Flap operation.*

a, b, c, semicircular incision on the dorsal surface of the wrist; the knife cutting the palmar flap.

Fig. 6.—*Wound and stump.*

a, b, c, form of the palmar flap.

DESCRIPTION OF THE OPERATIONS.

1. CARPO-METACARPAL DISARTICULATION OF THE FOUR FINGERS.

SINGLE FLAP OPERATION.

(Figs. 2 and 3.)

(1). The hand being strongly supinated, recognize, on the outer side, the articulation of the trapezium with the second metacarpal bone, and on the inner side the articulation of the unciform bone with the fifth metacarpal.

(2). Thrust through a narrow knife between the bones and the soft parts, passing it a little below the prominences of the unciform and trapezium, so as to bring it out a little below the thumb.

(3). Carry the blade of the knife downwards parallel to the anterior surface of the metacarpal bones, and cut a large palmar flap of elliptical form.

(4). Pronate the hand, and make a semilunar incision on the dorsal surface, carrying the whole blade across at about half an inch below the articulations.

(5). Whilst an assistant retracts the skin upwards, the surgeon holds the metacarpal bones of the patient with his left hand, and proceeds to disarticulate them from behind, commencing with the metacarpal bone of the little finger, or index, according to the hand operated upon.

2. Radio-carpal Disarticulation.

Firstly, the circular method (Fig. 4).

(1). One assistant forcibly retracts the skin of the fore-arm, whilst another holds the hand to be amputated.

(2). The surgeon makes a circular incision through the skin, and strikes the palmar and dorsal eminences.

(3). The skin is dissected and raised in the form of a sleeve as high as the radio-carpal articulation.

(4). A second circular incision is made, dividing the tendons.

(5). The joint is cut through from its dorsal towards its palmar surface.

(6). The styloid processes of the radius and ulna are to be sawn off.

Secondly, the single flap method (Figs. 5 and 6).

PLATE XXI.

DISARTICULATION OF THE ELBOW.

ANATOMY.

Fig. 1.—The articulation is formed by the extremity of the humerus (A), the upper extremity of the radius (B), and the upper extremity of the ulna (C).

Fig. 2.—The radius articulates with the humerus by juxtaposition only; but the ulna receives the trochlea into a cavity formed by the olecranon (*b*) posteriorly, and the coronoid process (*c*) in front. This anatomical disposition allows the joint to be attacked by the full knife only on its outer side.

The osseous surfaces are maintained in contact by anterior, posterior, and lateral ligaments.

Fig. 3.—To recognise the articulation the two condyles must be determined; the internal (*b*) is easily felt beneath the integument; the external (*a*) is less prominent, and indefinitely continuous with the external border of the humerus. The two condyles are situated on a nearly horizontal line (*a b*), to which the shaft of the humerus would be perpendicular. The articular interline (*c d e*) lies below the horizontal line (*a b*), and its two extremities (*c* and *e*) are unequally distant from it. In effect the external extremity (*c*) is about one-third of an inch below the lowest point of the external condyle, whilst the internal extremity (*e*) is three-fifths of an inch below the lowest point of the internal condyle.

OPERATIONS.

Fig. 4.—*Flap operation.*—*a*, *b*, *c*, form of anterior flap.

Fig. 5.—Anterior flap raised.—*a*, humero-radial articulation opened; *e*, anterior ligament not yet divided over the humero-ulnar articulation.

Fig. 6.—*Circular method.*—*a*, *b*, sleeve of skin raised.

Fig. 7.—Wound resulting from disarticulation by the circular method. *a*, inferior extremity of the humerus; *b*, section of the brachial artery.

STEPS OF THE OPERATIONS.

1. *Single flap.* (Figs. 4, 5.)

The forearm is to be forcibly supinated and slightly flexed; then the surgeon, standing on the inner side of the limb, embraces with his left hand the lateral parts of the articulation, and lightly draws upwards the skin of the forearm. With a narrow-bladed knife he punctures the limb on the inner side, about one inch below the prominence of the internal condyle, and after carrying the instrument in contact with the bones of the forearm brings it out at a point two inches below the external condyle, cutting an anterior semilunar flap three inches and a half in length. This flap is to be reflected by an assistant, who at the same time retracts the skin of the arm in order to raise up the angles of the wound, and the surgeon carries the knife outwards at the base of the flap, dividing all the tissues, and entering the joint full blade between the humerus and the radius; then with a transverse incision he circumscribes the limb, dividing all the structures on the posterior surface as far

PLATE XXII.

DISARTICULATION OF THE SHOULDER.

ANATOMY.

Fig. 1.—*a*, head of the humerus; *b*, clavicle; *c*, acromion process; *d*, infra-spinous fossa of the scapula; *e*, head of the humerus, held in the glenoid cavity by the capsular ligament.

Fig. 2.—*a*, glenoid cavity—an elongated pear-shaped facette which embraces one-third of the head of the humerus; *b*, acromion process; *c*, coracoid process.

The head of the humerus is attached to the glenoid cavity by a loose capsular ligament, which would permit the separation of the articular surfaces, were they not maintained in contact by the action of the several muscles which surround the joint.

The acromion and coracoid processes form an arch which protects the articulation above. The acromion, situated nearly two-fifths of an inch above the glenoid cavity, projects outwards over the joint for more than an inch. The coracoid, lower and more internal, is nearer to the head of the bone.

OPERATIONS.

Fig 3.—*a*, *b*, *c*, form of the posterior flap.

Fig. 4.—*a*, *b*, *c*, posterior flap reflected; *d*, head of the humerus disarticulated.

Fig. 5.—*a*, *b*, first incision, vertical; *c*, *d*, posterior incision, starting from the first; *c*, *e*, anterior incision, also starting from the first.

Fig. 6.—*a*, *b*, *c*, *d*, resulting wound of the amputation by preceding method; *e*, glenoid cavity and portions of the capsular ligament; *ff*, axillary vessels.

STEPS OF THE OPERATIONS.

1. *Disarticulation of the shoulder.—Double flap operation.*

(Figs. 3, 4.)

First step.—When the left shoulder is to be disarticulated, the arm is to be raised, and the humerus rotated inwards; then the surgeon assures himself by manipulation of the position of the acromion and coracoid processes, and with a long narrow knife, held nearly parallel with the humerus, punctures the posterior wall of the axilla at its extreme outer part, and immediately below the insertion of the latissimus dorsi and teres major.

The knife now passes along the posterior and outer surface of the humerus, and arrives beneath the acromion process. Its point is now slightly altered in direction, made to penetrate the capsule of the joint, and is brought out in front of the clavicle in the triangular space between the acromion and coracoid processes and the clavicle. The deltoid is next seized with the left hand, and the knife descends full blade on the outer side of the humerus, to cut an external or posterior flap about three inches and a half in length. In this flap the knife has divided the tendons of the latissimus dorsi, teres major, teres minor, a large portion of the deltoid, and the capsule of the joint.

Second step.—After cutting this flap, the head of the humerus is easily drawn away from the glenoid cavity, and may be rotated first outwards, then inwards, in order to cut through the attachments of the subscapularis, supra-spinatus, and infra-spinatus. The blade is now passed through the joint behind the head of the bone, and is carried along the inner surface of the bone, to form the anterior or internal flap; at the same time the artery which is contained in the thickness of the flap is readily compressed by the assistant. When the right shoulder is to be

PLATE XXIII.

DISARTICULATION OF THE TOES.

ANATOMY.

Fig. 1.—*Osteology of the foot—dorsal surface.*—*a* and *b*, inferior extremities of the tibia and fibula ; *c*, astragalus ; *d*, os calcis ; *e*, scaphoid ; *f*, cuboid ; *g*, internal cuneiform ; *h*, middle cuneiform ; *i*, external cuneiform ; 1, 2, 3, 4, 5, first, second, third, fourth, and fifth metatarsal bones ; *k*, phalanges.

Fig. 2.—*Ligaments in the dorsal surface of the foot.*—*a*, *a*, anterior tibio-astragaloid ; *b*, anterior fasciculus of external lateral ; *c*, internal calcaneo-scaphoid ; *d*, calcaneo-astragaloid ; *e*, superior astragalo-scaphoid ; *f*, superior calcaneo-cuboid ; *g*, *g*, *g*, scapho-cuneiform ; *h*, cubo-metatarsal ; *i*, *i*, *i*, cuneo-metatarsal ; *k*, metatarso-phalangeal articulations ; *l*, lateral ligaments of the phalangeal joints.

Fig. 3.—*Horizontal section of the tarsal bones ; inter-osseous ligaments.*

OPERATIONS.

Fig. 4.—*Disarticulation of the first and third toe.*—*a*, *b*, *c*, *d*, wound resulting from disarticulation by the oval method ; *e*, head of the first metatarsal bone ; *f*, *g*, *h*, wound resulting from disarticulation by the double flap operation ; *i*, head of the third metatarsal bone.

Fig. 5.—*Disarticulation of the five toes.*—*a*, *b*, *c*, form and direction of the incision to be made in front of the heads of the metatarsal bones.

Fig. 6.—The integuments being retracted, the knife glides beneath the toes to cut a plantar flap.

Fig. 7.—Wound resulting from preceding operation.—*a*, *b*, *c*, form of the plantar flap.

Fig. 8.—*Disarticulation of the first metatarsal bone.*—*a*, *b*, *c*, *d*, racket form incision.

Fig. 9.—*a*, *b*, *c*, incision for removal of the first metatarsal bone by disarticulation, without the toe (see resections).

STEPS OF THE OPERATIONS.

1. *Disarticulation of a single toe.* (Fig. 4.)

The description of the disarticulation of the fingers is in every respect applicable to that of the toes, so that it is unnecessary here to repeat. It may be well to state, however, that the oval operation is most commonly employed, because a toe is generally removed in its entirety, the small size and inutility of the phalanges not indicating their preservation as in the hand.

Many surgeons advise, in the disarticulation of the great toe (fig. 8), the removal at the same time of the head of the metatarsal bone, otherwise its prominence produces a deformity which is painfully irritated by the shoe. (See resections for this special case, and for amputation of the metatarsal bones.)

2. *Disarticulation of the five toes.—Flap operation.* (Figs. 6, 7.)

(1.) The operator, grasping all the toes in his left hand, makes, with a narrow knife, a semicircular incision extending on the left foot, or on the right foot *vice versa*, from the inner side of the head of the first metatarsal bone to the outer side of the head of

PLATE XXIV.

TARSO-METATARSAL DISARTICULATION. (HEY'S OR LISFRANC'S OPERATION.)

ANATOMY.

Fig. 1.—The tarso-metatarsal articulation—formed behind by the cuboid (*a*) and the three cuneiforms (*b*, *c*, *d*); in front by the five metatarsal bones—presents an irregularly curved line, the direction and sinuosities of which should be well understood.

Externally the cuboid (*a*) articulates with the fifth and fourth metatarsal bones, the line running obliquely from without inwards, and from behind forwards. This line is slightly broken, the articulation with the fourth metatarsal being more transverse than that with the fifth. About one-twelfth of an inch more in front is the articulation of the third metatarsal bone with the external cuneiform (*b*); again, one-eighth of an inch to the rear is the articulation of the second metatarsal bone with the middle cuneiform (*c*); lastly, about one-third of an inch in front of the preceding is the articulation of the first metatarsal bone with the internal cuneiform (*d*).

This anatomical disposition presents to the notice of the operator two essential points:—(1) The internal extremity of the tarso-metatarsal articulation situated nearly three-quarters of an inch in front of a line (*e*, *f*) drawn transversely from the external extremity. (2) The base of the second metatarsal bone morticed in by the three cuneiform bones.

The dorsal cubo-metatarsal and cuneo-metatarsal ligaments are connected with the bones at some distance either in front of or behind the articular interline, a disposition which admits of a separation at the joints when the ligaments are divided not precisely at a level with the interline. The inter-osseous ligaments, more powerful on the plantar than on the dorsal surface, are easily divided; those, however, which are connected with the second metatarsal bone in the mortice—the veritable key of the articulation—offer a resistance which necessitates a particular manœuvre for their division.

In order to recognise the articulations, (1) On the inner side, follow with the finger, from before backwards, the inner side of the first metatarsal bone as far as the tuberosity (*g*); a tenth to a twelfth of an inch behind this is the articular interline corresponding to an indentation between the tuberosity (*g*) and the tuberosity (*h*) of the internal cuneiform. Again the articulation may be found at about an inch in front of the tuberosity of the scaphoid bone (*i*).

(2.) On the outer side, follow with the finger, from before backwards, the outer side of the fifth metatarsal bone as far as the tuberosity (*k*); the joint commences immediately behind and internal to this, but in some cases this tuberosity projects beyond the articulation.

OPERATION.

Fig. 1 *bis* (repeated).—*a*, *b*, *c*, form and direction of the incision to be made in front of the tarsal bones.

Fig. 2.—*a*, *b*, *c*, dorsal tarso-metatarsal ligaments divided.

Fig. 3.—Operative manœuvre for luxating the key of the articulation. *a*, *b*, *c*, arc of a circle described by the knife; *d*, dividing all the tissues as far as the bones, and connecting the two extremities of the articulation.

Second step.—The surgeon carries the point of the knife on the outer side of the articulation, there penetrates and opens the joint as far as the external cuneiform bone. He now carries the point of the knife one-twentieth of an inch forward, incises transversely, and opens the articulation as far as the second metatarsal bone. He next attacks the articulation of the first metatarsal bone (fig. 2).

Third step.—It remains to destroy the mortice which engages the head of the second metatarsal bone within the bones of the tarsus. For this purpose the point of the knife is introduced between the internal cuneiform bone and the second metatarsal, in such a manner that the cutting margin is turned upwards, and inclined at an angle of forty-five degrees with the toes; then the knife is raised to a right angle, at the same time passing along the inner side of the mortice to divide the internal inter-osseous ligament. Now the surgeon withdraws the knife, and with its point divides the posterior and external dorsal ligaments of the mortice.

Fourth step.—All the means of union being divided, light pressure is applied to the end of the foot to separate the articular surfaces, and the inter-osseous ligaments which still remain intact are successively divided. Next the plantar ligaments are cut through, and the knife glided beneath the bases of all the metatarsal bones, avoiding the tuberosities of the first and fifth. There remains only to cut the plantar flap, two inches and a half long on its inner side, and one inch and a half on its outer.

PLATE XXV.

MEDIO-TARSAL DISARTICULATION, TERMED CHOPART'S.

Anatomy.

Fig. 1.—The medio-tarsal articulation—formed posteriorly by the astragalus (*a*) and the calcaneum (*b*) ; in front by the cuboid (*c*) and the scaphoid (*d*)—presents a transverse articular line curved like an italic *S*, of which the anterior convexity is internal, and the posterior convexity external. The *internal extremity* of the articulation is about one inch in front of the internal malleolus (*g*), and one-fifth of an inch behind the tuberosity (*h*), of the scaphoid.

The *external extremity* (*i*) is three-fifths of an inch behind the tuberosity (*j*) of the fifth metatarsal bone. It corresponds to a prominence which the cuboid forms where articulating with the calcaneum, a prominence situated on the outer border of the somewhat obliquely (*e*), will be elevated a little (*d*) between the calcaneum (*a*) and the cuboid (*b*) when attacking the joint on its outer side. The internal ligament which occupies the centre of the region, and which unites three bones, and holds the four together, should be divided by the point of the knife as soon as the separation of the bones will permit. In old subjects it is sometimes ossified, a peculiarity which necessitates the use of the saw. The other ligaments require no further notice.

OPERATIONS.

Fig. 4.—*Ordinary operation.*—*a*, *b*, *c*, form and direction of the incision in front of the joint.

Fig. 5.—The joint opened, the knife cutting the plantar flap. *a*, dorsal artery of foot.

Fig. 6.—*a*, *b*, *c*, form of the plantar flap; *d* and *d′*, dorsal and plantar arteries.

Fig. 7.—*Sedillot's operation.*—*a*, *b*, *c*, form of the anterior incision.

STEPS OF THE OPERATIONS.

CHOPART'S MEDIO-TARSAL DISARTICULATION. (Figs. 4, 5.)

1. *Ordinary operation.*—(1.) The line of articulation having been made out as already explained, grasp the sole of the foot with the palm of the left hand, placing the thumb on the outer side of the articulation (if it be the right foot), and the index or middle finger on the tuberosity of the scaphoid. (2.) Make a semilunar incision, extending from the thumb to the index, across the dorsum of the foot, and descending three-fifths of an inch below the joint. (3.) After having retracted the integument, the knife must be carried back in the wound, to divide the tendons, and to open the articulation; the directions of the articular surfaces already pointed out must be recollected, and care must be taken to divide all the fibrous bands which unite the scaphoid with the astragalus, by the whole blade, without attempting to penetrate the joint with the point of the knife, a movement which is rendered impossible by a slender ledge of the scaphoid bone overlapping the head of the astragalus. (4.) Gentle pressure with the left hand upon the foot enables the surgeon to

define more clearly the line of the articulation, and also to distinguish fibrous bands which may yet remain uncut. (5.) The articulation being freely opened, and all the means of union divided as far as the plantar surface, the blade of the knife is passed behind the bones, and the fore part of the foot bent at a right, angle, in order that it may be glided beneath them ; then returning the foot to its natural position, the plantar flap is cut, the knife being brought out at a point one-fourth of an inch in front of the sesamoid bones. In cutting this flap, care must be taken to prevent the blade being arrested by the projecting portions of the scaphoid, cuboid, and first and fifth metatarsal bones.

2. *Operation of M. Sedillot.* (Figs. 6, 7.)

After having recognized the outline of the articulation, a transverse incision is to be made, starting from a point a little in advance of the calcaneo-cuboid articulation, and terminating in the middle of the dorsum of the foot, external to the tendon of the tibialis anticus. From this point a second incision is to be made obliquely from behind forwards, and from without inwards,

PLATE.XXVI.

ANATOMY.

Fig. 1.—*Tibio-femoral articulation, anterior surface.* *a*, femur ; *b*, patella ; *c*, tibia ; *e*, fibula ; *g*, external lateral ligament ; *f*, internal ligament ; *d*, inferior patellar ligament.

Fig. 2.—Antero-posterior vertical section, showing the crucial ligaments, *d*, and the popliteal artery, *e* ; *a*, femur ; *b*, tibia ; *c*, patella.

This articulation presents some important anatomical peculiarities. The internal condyle of the femur descends lower than the external by two-fifths of an inch. Both are received into concave facettes on the tibia ; the semilunar cartilages adherent to the tibia fill up the space of the glenoid cavity in which each condyle rolls. The popliteal artery (fig. 2, *e*), lodged in the posterior intercondyloid space, is in immediate contact with the posterior surface of the articulation.

The means of union are—in front, the superior and inferior patellar ligaments ; on the sides, the external and internal lateral ; behind, the posterior ligament. Independently of the exterior ligaments, two crucial ligaments, strong and resisting, maintain the osseous surfaces in contact, and limit their movement.

In order to recognize the line of articulation, (1) the head of the fibula must be felt ; the articulation is about four-fifths of an inch above. (2) The femur presents, upon the lateral surfaces of its condyles, two tubercles, the most prominent points of which may be easily felt beneath the integument ; at about four-fifths of an inch below each is the joint. Finally, (3) the lower border of the patella is at the level of the articulation.

OPERATIONS.

Fig. 3.—*Disarticulation of the knee—flap operation.*

a, *b*, *c*, form of the anterior incision.

Fig. 4.—Same operation. Articulation opened, the knife cuts the posterior flap. *a*, *b*, *c*, form of the flap.

Fig. 5.—Disarticulation of the knee—circular method.

a, *b*, *c*, section of the skin; *d*, *e*, sleeve of skin raised; the knife enters the articulation anteriorly.

Fig. 6.—Disarticulation of the knee—oval method.

a, *b*, *c*, oblique section of the skin; *d*, *e*, the skin raised; the knife enters the joint from before backwards.

STEPS OF THE OPERATIONS.

1. *Disarticulation of the knee—flap operation.*—(1) The leg being extended, make a semilunar incision in front of the knee, and below the patella, extending from one condyle of the femur to the other. (2) Flex the knee, and make a second incision in the line of the first, freely opening the joint. (3) Divide the lateral and the crucial ligaments. (4) Carry the blade of the knife behind the tibia and the fibula, and cut a flap at the expense of the muscles of the calf, of sufficient length to cover the wound —about four inches.

2. *Circular method.*—(1) Make a circular incision through the skin and cellular tissue around the leg, three or four fingers'

PLATE XXVII.

DISARTICULATION OF THE THIGH.

ANATOMY.

Fig. 1.—*a*, Internal iliac fossa ; *a'*, femoral artery; *b*, femur ; *c*, head of femur covered by the capsular ligament ; *d*, anterior superior iliac spine ; *e*, anterior inferior iliac spine ; *f*, spine of the pubes ; *g*, tuberosity of the ischium ; *h*, lesser trochanter. The ilio-femoral articulation is formed by the acetabulum and the head of the femur ; the head of the femur is not completely received into the cotyloid cavity, but is maintained there by a large and resisting capsular ligament, and by the round ligament, a fibrous cord which attaches the head of the femur to the depth of the cavity. The capsular ligament is attached to the anterior inferior iliac spine and to the circumference of the cotyloid cavity. It must be incised very near its cotyloid attachments, cutting around the prominence of the acetabulum in order to easily disengage the head of the femur. The plane of the circumference of the cotyloid brim looks obliquely forwards and downwards, whence it results that the head of the femur is more covered behind than in front, a point which it is well to know in order not to be misled by the cotyloid prominence when attacking the joint from behind. In order to recognise the articulation, we must be guided by the following anatomical data:—

1. The anterior inferior iliac spine is four fifths of an inch above the circumference of the cotyloid cavity ; the anterior superior iliac spine is nearly two inches above the same cavity, and four-fifths of an inch external to it.

2. When the patient is standing, an oblique line passing from the anterior superior iliac spine to the tuberosity of the ischium traverses the cotyloid cavity at the junction of its posterior third with its anterior two-thirds.

3. The anterior rim of the cotyloid cavity is one inch and a half external to the spine of the pubes.

4. The axis of the horizontal ramus of the pubes prolonged by an imaginary line would traverse the cotyloid cavity at the junction of its upper with its middle third.

5. The superior border of the great trochanter is on a level with the upper third of the ilio-femoral articulation.

This articulation, superficial in front, where it is only covered by the psoas and iliacus, and the vessels, is protected internally and behind by a considerable mass of muscles; externally the muscular mass is less abundant.

The *femoral artery* (A') passes in front of the joint, on a level with the junction of the middle third with the internal third of the head of the femur; lower down it approaches the shaft of the femur, and crossing behind it becomes the popliteal artery.

OPERATIONS.

Fig. 2.—*Disarticulation of the thigh—flap operation.* —The knife transfixed from without inwards cuts the anterior flap, *a*, *b*, *c*.

Fig. 3.—*Same operation.*—The flap is raised by the hands of an assistant, who compresses the vessels in his grasp; the head of the femur, *b*, is luxated, and the knife passed behind it to cut the posterior flap; *c*, *c*, section of the femoral vessels.

Fig. 4.—*Wound resulting from the preceding operation.*—*a*, *b*, *c*, an anterior semilunar flap five inches in length. An assistant, who has his thumb compressing the femoral artery on the pubes, thrusts his fingers into the wound as the knife proceeds, and raises the flap as soon as it is cut, now grasping the femoral vessels in its thickness. A second assistant, who holds the leg with his right hand, and the lower part of the thigh with his left, now abducts the thigh, rotates it outwards, and forcibly extends the hip joint, so as to make the head of the femur prominent within the capsule. The surgeon next rapidly cuts through the capsule, and the head protrudes, exposing the ligamentum teres, which is at once cut, together with posterior fibres of the capsular ligament, and the dislocation of the bone completed. The second assistant now draws upon the leg so as to increase the space between the head of the femur and the haunch bone, and at the same time adducts and rotates the limb inwards, to bring the trochanter major to the front. In this position the surgeon can easily divide the muscles connecting the trochanter with the trunk, and he now carries the knife backwards between the femur and the haunch bone, and divides the soft tissues vertically, without making a posterior flap.

There are some modifications of the flap operation: thus, Larrey tied the femoral artery before commencing the operation; Ashmead cut the anterior flap from the skin downwards into the deeper tissues; Lenoir, after making the anterior flap, cut the structures behind by a circular incision before proceeding to disarticulate; Lalouette and Delpech made an internal instead of an anterior flap.

2. *Double lateral flap operation.* (Figs. 5, 6.)

The patient lying with the buttocks projecting beyond the bed, the surgeon proceeds to make out the exact position of the anterior and external parts of the joint according to the anatomical data above given. He then thrusts in the knife immediately to the outer side of the articulation, with the edge of the blade towards the great trochanter, making the point to pierce immediately below the tuberosity of the ischium. As the knife is about to penetrate the posterior surface of the thigh, an assistant draws the skin outwards, in order to increase the size of the outer flap. By a sawing movement the knife is now turned around the great trochanter, and then along the outer side of the femur to cut an external flap (*a*, *b*, *c*, fig. 6), about two and a half to three inches in length.

To form the internal flap, the soft parts are drawn inwards by an assistant, and the knife, with the edge directed downwards, is thrust through the limb, entering in front immediately beneath the head of the femur on the inner side of the neck of the bone, and passing out posteriorly in the posterior superior angle of the former incision: care is to be taken not to strike the point of the knife against the pelvis. The knife is now carried downwards, grazing the inner surface of the bone, and avoiding the lesser trochanter, to cut an internal flap (*d*, *e*, fig. 6), the same length as the outer flap. The flaps are to be pressed aside by an assistant, and the arteries tied, and the surgeon, seizing the femur with his left hand, draws the edge of the knife down the capsular ligament, over the head of the bone, and opening the joint, completes the disarticulation.

3. *Oval operation.*

AMPUTATIONS IN THE CONTINUITY OF THE BONES.

PLATE XXVIII.

AMPUTATIONS OF THE FOOT AND HAND.

OPERATIONS.

Fig. 1.—*Amputation of a phalanx.*—*a*, a tape or small bandage to retract the soft tissues; *b*, position of the left hand of the operator seizing the extremity of the finger, whilst the right, armed with Liston's bone forceps, *c*, severs the bone.

Fig. 2.—*Amputation of the fifth metacarpal bone.*—*a*, the bone sawn obliquely from above downwards, and from within outwards, the hand being pronated; *b*, bandage protecting the soft parts from the saw.

Fig. 3.—*Amputation of four inner metacarpal bones—circular method.*—*a a*, tapes passed between the bones in order to draw back the soft parts whilst the bones are sawn through.

Fig. 4.—*Amputation of the metatarsal bones—plantar flap operation.*—Tapes are passed between the bones as in amputation of the metacarpal bones.

Fig. 5.—*Same operation completed.*—*a*, *b*, *c*, form of the plantar flap.

STEPS OF THE OPERATIONS.

1. *Amputation of phalanges.* (Fig. 1.)

The circular method is generally employed. After cutting through the skin by a circular incision, it is to be dissected upwards a quarter of an inch; the tissues surrounding the bone are then divided, particularly the tendinous sheaths on the palmar surface; after which the bone may be cut through with a watchmaker's saw, or with the bone forceps. The skin is to be drawn down over the osseous extremity, and the sutures applied to form a transverse cicatrix, a position the least exposed to injury in flexion of the fingers.

2. *Amputation of a metacarpal bone, and of the finger which it supports.*

It is convenient in this case to employ the oval operation, absolutely the same as in the dislocation ; only, when the bone is uncovered, a piece of wood or cardboard should be passed behind it to keep off the tissues, and protect them from the saw. The saw employed is one of small size, termed the metacarpal saw. The fifth metacarpal bone should be cut obliquely from within outwards, and the second obliquely from without inwards.

It is difficult to use the saw in dividing the third or fourth metacarpal bone, bone forceps are therefore substituted. Experience shows that whether the forceps or the saw is used is a matter of no import so far as concerns cicatrisation.

3. *Amputation of the four metacarpal bones.* (Fig. 3.)

A flap is made in the palm, and the operation performed is precisely the same as for disarticulation of the four fingers, (see Plate xx., fig. 2); then with a narrow finger knife the bones should be freed of their muscles and periosteum ; after which a five-headed bandage may be arranged in the inter-osseous spaces to protect the tissues from the saw.

4. *Amputation of a single metatarsal bone, and of the toe which it supports.*

PLATE XXIX.

AMPUTATION BY A LONG AND SHORT RECTANGULAR FLAP. (TEALE'S OPERATION.)

There is a variety of the flap operation introduced by Mr. Teale, and by him termed amputation by the long and short rectangular flap, which is applicable to any amputation in the continuity of the bones, and may therefore be here described once and for all.

It consists of two flaps, which involve all the tissues down to the bone, the anterior being four times the length of the posterior, and great stress is laid by the originator on the necessity of avoiding any large bloodvessel or nerve in the formation of the anterior flap, which it will be seen forms the main cushion beneath the cut ends of the bones.

Each flap is quadrangular, and corresponds to one half the circumference of the limb. Two lateral incisions, one on each side the limb, are first made, commencing at the point where it is intended to divide the bone, and carried downwards to a distance measured precisely equal to one half the length of the circumference of the limb. The lower extremities of these two vertical lines are united by a cross cut over the front of the limb, carried through all the tissues down to the bone. The anterior flap thus marked out is to be dissected up from the bone or bones as high as the point where the limb is to be amputated, and where the vertical lines commenced.

In making the posterior flap, the knife is carried in one sweep through the skin and tissues down to the bone at a point measured down the vertical lines one-fourth their length, and the flap is then to be dissected up to the same level as the anterior flap, so that the posterior flap is one-fourth the length o the anterior. When the skin is approximated by sutures, the anterior flap wraps around the ends of the bones, and the junction of the flaps is in a dependent position convenient for the escape of pus.

In making the vertical incisions, the main arteries can generally be avoided; for instance, in the arm or thigh, the internal incision would be immediately in front of the line of the brachial or femoral artery, whilst the external incision would be on the opposite side of the limb, half-way round, measured from the internal.

In the forearm these incisions would be made along the prominent parts of the radius and ulna, and in the leg along the posterior borders of the tibia and fibula.

It will be readily seen that a serious disadvantage in this operation is the great length of the anterior flap, and corresponding amount of damage done to the soft parts, and consequently the tendency of this flap to slough.

AMPUTATION OF THE FOREARM AND OF THE ARM

OPERATIONS.

Fig. 1.—*Amputation of the right forearm—circular method.*—*a*, hand of an assistant supporting the forearm. The operator standing outside the limb, incising the muscles.

Fig. 2.—Same operation—third step. A three-headed bandage, and conical, it will be necessary to divide the skin laterally in order to be able to raise it.

Second step.—Divide the muscles in a circular manner, following the outline of the sleeve of skin. In this incision the deep muscles escape the knife, it is therefore necessary to divide them by passing the knife through the interosseous space, first on the extensor, and then on the flexor aspect, dividing all the tissues around each bone (see amputation of the limb, plate xxx., fig. 2 and 2 *bis*).

Third step.—Introduce a three-headed bandage into the interosseous space, wherewith to raise the soft tissues, then apply the saw to both bones at the point where they cease to be denuded, and draw it once or twice from heel to point, guided by the nail of the left thumb, until its teeth become engaged. Now with the saw cut through both bones. It will be found that the section of the radius will be completed first. When the section of the ulna is nearly completed, the action of the saw should be directed with care, and the assistant who holds that part of the limb to be removed should avoid all pressure on the bones, otherwise the end of the bone will be splintered instead of being cut clean, an accident very liable to result in necrosis of the stump.

Fourth step.—Ligature the arteries which are the radial and ulnar, anterior and posterior interosseous ; then, the skin being turned down, adapt it with sutures in such manner as to obtain a transverse cicatrix.

2. *Double flap operation.*

The arm is to be supported by an assistant almost at right angles to the body, the operator standing outside the right arm or inside the left.

The anterior flap is to be first cut by transfixion.

(1) The assistant holding the limb forcibly supinated, feel the limits of both bones with the thumb and index finger of the left hand ; then (2) transfix the limb immediately in front of both bones, and cut a semilunar flap, including the muscles, about two and a half to three inches in length.

The assistant now forcibly pronates the limb whilst the posterior flap is cut.

(1.) Do not transfix to make this flap, but with the full blade cut a semilunar flap two inches in length downwards from the surface to the aponeurosis, commencing from the one angle at the base of the anterior flap, and carrying the incision round to the other angle. (2.) Dissect the skin and cellular tissue as high as the base of the anterior flap. (3.) Let the assistant raise both flaps; then by a circular incision, and by piercing the interosseous membrane, denude the bones. (4.) Cut through the bones with the saw, as explained in the preceding operation.

Amputation of the arm—circular method. (Figs. 3, 4.)

The arm being held by an assistant at right angles to the patient, the surgeon is to stand external to the limb, and proceed as follows:—

First step.—Incise in a circular manner the skin and cellular tissue as far as the aponeurosis; the skin which is loosely connected may be easily retracted.

Second step.—With a second circular incision at the level of the retracted skin, cut through the muscles as far as the bone. The assistant now retracts the skin, and also the mass of

PLATE XXX.

AMPUTATION OF THE LEG.

OPERATIONS.

Fig. 1.—*Amputation at the seat of election.* * *Circular method.*

a, *b*, *c*, Circular incision through the integuments ; *d*, sleeve of skin raised. The knife commencing to incise the muscles.

Fig. 2 *and* 2 *bis.*—*Same operation.*—Section of the deep muscular parts about the bone.

Fig. 3.—*Same operation.*—A three-headed bandage (*a a*) passed between the bones, serves to retract the soft parts and protect them against the saw.

Fig. 4.—*Wound resulting from the preceding operation.*—The hand of an assistant (*a*) supports the sleeve formed by the integument ; *b*, *b*, *b*, vessels of the leg.

Fig. 5.—*Amputation of the leg at the lower part : M. Lenoir's operation.*—Appearance of the wound after the operation ; *a*, *b*, angular flaps formed by the division and dissection of the skin forming a sleeve split in front ; *c*, tibia ; *d*, fibula.

STEPS OF THE OPERATIONS.

(1.) *Amputation of the leg two or three fingers' breadth below the tuberosity of the tibia. Circular method.* (Figs. 1, 2, 2 *bis*, 3).

The patient lies with both legs projecting beyond the table, and the assistant holding the limb to be amputated in a horizontal position.

First step.—The assistant retracts the skin; then, by a circular incision, the skin and cellular tissue are to be cut through. The incision should be commenced at the crest, and completed in one sweep. The skin is next to be dissected upwards for about two inches, and then turned up as a sleeve.

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* The term, "seat of election," was applied to a point two or three inches below the knee-joint. It was the rule to amputate at this point in patients among the working classes who would be compelled to wear the wooden peg, the object being to avoid the long stump projecting at right angles to the knee.

Second step.—The knife is to be carried in a circular manner through the tissues as far as the bones on a level with the skin turned up.

Third step.—The knife is carried around each bone, through the interosseous membrane (*see* figs. 2 and 2 *bis*, in which a double-edged knife is used), and the three-headed bandage introduced.

Fourth step.—The saw is now to be applied to the tibia, directed by the left thumb, and drawn from heel to point two or three times, until its teeth become engaged; the section of the two bones is then to be completed, taking care that the fibula shall be divided before the tibia, otherwise the former bone will be splintered.

Many surgeons saw off the projecting crest of the tibia to avoid its puncturing the integument.

The arteries to be ligatured (fig. 4) are the anterior and posterior tibial, the peroneal, and sometimes the sural arteries.

M. Lenoir's operation (fig. 5) differs from the ordinary of the thumb, behind the two bones, and, grazing the surface of the bones, it should come out at the point of the index finger. The knife is then carried downwards, to cut a posterior semilunar flap three inches or more in length, according to the size of the limb, and to the part of the limb on which the operation is being performed.

The anterior flap is to be cut in the skin only. The blade of the knife is to be applied to one angle of the wound at the base of the posterior flap, and drawn across the front and outer part of the limb, through the skin and cellular tissue only, to cut a semilunar flap two inches and a half in length. The integument is then to be dissected up to a level with the base of the first flap. The next step is to denude the bones, by cutting around them, and through the interosseous membrane. The bones may then be sawn through, and the crest of the tibia removed at discretion. If this operation be performed in the upper third of the leg, a superabundance of muscle is cut in the posterior flap, and it is necessary to slice away the excess after the flap is cut. For this reason, it is usual to perform either the circular or the skin flap operation in this region.

Long and short rectangular flaps (Teale's operation), see description (page 85).

PLATE XXXI.

AMPUTATION OF THE THIGH.

OPERATIONS.

Fig. 1.—*Circular method.—Ordinary plan.*—The hand of an assistant, *a*, compresses the femoral artery; *b*, *c*, *d*, circular incisions of the integuments.

Fig. 2.—The same operation. The muscles having been cut through as far as the bone, a split bandage, *a*, *a*, is applied in order to raise the soft parts and to protect them from the saw.

Fig. 3.—The same operation finished—view of the stump; *a*, section of the femur; *b*, orifices of the femoral vessels.

Fig 4.—*The flap operation.—M. Sédillot's method.*—*a*, the first flap raised; the knife, *b*, plunged in obliquely, cuts a second flap in the line, *c*, *d*.

STEPS OF THE OPERATIONS.

The circular method.—Ordinary plan (Figs. 1, 2, 3).

The patient lying down, the thigh slightly flexed upon the pelvis, and uncovered throughout, should be kept sufficiently apart by assistants. The surgeon should stand on the inside of the limb.

transfixion. The point of the knife may be entered on either side, carried beneath the bone and slightly raised, to be brought out about the central part of the opposite side. If possible, it is well to keep the main vessel in the posterior flap, as less important branches would be severed by so doing. The knife is now carried obliquely downwards to the surface, to cut the posterior flap. The anterior flap is not made by transfixion. The knife is carried from one angle of the base of the posterior flap round on the anterior surface of the thigh to the opposite angle, forming a flap in the skin and cellular tissue about the size and shape of, or slightly shorter than, the posterior flap, which has been already cut. At the discretion of the operator the integument and cellular tissue may be now dissected up to the level of the base of the posterior flap, or the knife may be carried more deeply in order to raise the muscles also in the flap. Next, both flaps are raised by the assistant, the knife carried in a circular manner around the bone, and the saw applied. The arteries that may require a ligature are the femoral, perhaps the deep femoral, according to position of the amputation, perforating and muscular branches.

Lateral flaps.—Vermale amputated the thigh by two lateral flaps, with the object of giving a more free exit to the discharges. Both flaps are formed by transfixion, the knife being entered in front of the femur at a central point, passed around the bone, and brought out at a corresponding point on the opposite side. The flaps are then cut of an equal length, the outer one being the first made because not containing any vessel of importance.

Teale's long and short rectangular flap.—(See page 85.)

Single skin flaps have been described by Carden and Spence. In this operation a long flap is cut in the skin and cellular tissue only on the front of the thigh; this flap being turned back, the knife is carried, at the base of the flap, in a circular manner, through all the soft tissues around the bone, including the skin on the back of the thigh.

Reason and practice teach us to avoid single skin flaps, owing to their tendency to slough; but occasions occur in which disease or injury leave the surgeon little choice in the matter. Mr. Carden proposes the operation for amputation immediately above the condyles.

Supra condyloid amputation (Gritti).—This operation consists of an anterior skin flap, carried a little below the patella, and made to include that bone, so that when the flap is applied, after the condyles are sawn off, the posterior surface of the patella, first denuded of its cartilage, is in contact with the cut end of the shaft of the femur. A posterior flap is also formed, the lower extremity of which reaches only to a level with the head of the fibula.

PLATE XXXII.

ESECTIONS WHICH ARE PERFORMED ON THE UPPER EXTREMITY.

Operations.

Fig. 1.—*Resection of the wrist joint.—M. Velpeau's plan.*—*a*, *b*, *c*, *d*, the quadrilateral flap of skin cut from the posterior surface of the radio-carpal articulation.

Fig. 2.—*Resection of the inferior extremity of the ulna.*—*a*, triangular flap of skin raised up; *b*, inferior extremity of the ulna; *c*, spatula passed under the bone to protect the soft parts from the action of the saw, *d*.

Fig. 3.—*Resection of the elbow joint.—M. Moreau's plan.*—*a*, hand of the assistant raising the quadrilateral flap which has been dissected from below upwards, in order to expose the joint from its posterior aspect; *b*, spatula inserted beneath the inferior extremity of the humerus while the bone is excised by the saw, *c*.

the first is then made, which, running in the direction of the other commissure, will thus form a V-shaped flap, with its base below. Having dissected and turned back this flap, the extensor tendon is to be drawn aside without dividing it, and the interosseous muscles detached on each side. The joint is then exposed by cautiously cutting through the lateral ligaments so as not to disturb the flexor tendons. The phalanx is then dislocated from behind, circumscribing as exactly as possible the diseased parts. At this stage of the operation, the bone, or its head, is cut with Liston's forceps, or by means of a little tail-like or metacarpal saw, taking care to pass underneath the bone a piece of wood or cardboard, for the sake of protecting the soft parts. In performing this operation on the index or the little finger, it will be as well to form the flap upon the free side of the finger so as not to expose the extensor tendon.

2. *Extraction of the first phalanx.*

Performed upon the thumb with success, and with the preservation of the movement of the small phalanx. This operation may also be indicated in the case of the other fingers.

An incision should be made upon the dorsal surface of the phalanx, commencing about ¾ of an inch above the metacarpo-phalangeal articulation, and prolonged to about ¼ of an inch beyond the articulation of the first phalanx with the second, The skin is next to be dissected and the tendons drawn aside, after which the metacarpal joint is exposed by cutting through the lateral and capular ligaments, and without disturbing the flexor tendons. The phalanx is then completely dislocated, and at the same time well cleared, while its extraction is completed by exposing its inferior articular surface.

3. *Resection of the metacarpal bones.*

(1.) A longitudinal or crucial incision is to be made upon the dorsal surface of the metacarpal bone to be operated on, the extensor tendons being drawn to one side. (2.) The interosseon muscles are to be divided on each side, and either the carpo-meta-carpal or the metacarpo-phalangeal articulation exposed according to the intention of removing the upper or the lower half of the metacarpal bone. (3.) After having properly protected the soft parts by means of a small bandage passed under the metacarpal bones, the diseased bone is removed with Liston's forceps or with the chain-saw. (4.) The excision completed, the fragment of excised bone is to be turned round from before backwards in order to complete its separation from the soft parts.

When the first or the fifth metacarpal bone is to be removed, the section of the bone should be made in an oblique direction, so as to avoid the angular projection which would inevitably result from a perpendicular section (Plate XXVIII., fig. 2).

4.—*Resection of the wrist joint.*

In performing this operation we can either remove the lower end of the radius alone, that of the ulna alone, or the carpal extremities of both bones together with all the carpal bones and the bases of the metacarpal bones.

(*a.*) *Resection of the lower end of the ulna* (Plate XXXII. fig. 2).

effected by carefully detaching the surrounding soft parts, especially avoiding injury to the tendons and also to the radial and ulnar arteries which lie in front; (4) a piece of cardboard or a spatula passed beneath the bones will protect the soft parts whilst the saw severs the bone.

In M. Dubled's operations two longitudinal incisions are made over the radius and ulna respectively. By the internal incision he extirpates the ulna, then he passes to the end of the radius, which he disarticulates and cuts out by means of the external incision.

M. Roux joins to the longitudinal incisions of M. Dubled two transverse incisions, which extend upon the back of the wrist as far as the border of the group of extensor tendons; the two transverse incisions are thus separated by a portion of skin corresponding to the middle of the back of the wrist, which protects the extensor tendons.

M. Velpeau reunites the two longitudinal incisions of M. Dubled by a tranverse one made above the wrist joint. The result is a large quadrilateral flap with its base below, and which is dissected and reflected from above downwards. In other respects the operation is the same.

Resection of the wrist joint, including the carpus and bases of the metacarpal bones.—Lister's operation.—Two incisions are made on the back of the hand. The *radial incision* is planned to avoid injury to the radial artery and to the extensor secundi internodii pollicis and extensor indicis. It is commenced at a point in the middle of the lower extremity of the radius level with the styloid process, and carried with a slight obliquity outwards to the outer side of the carpo-metacarpal articulation of the index finger parallel with the extensor secundi internodii pollicis; it is now turned parallel with the outer border of the second metacarpal bone for half its length. The soft tissues over the trapezium are now raised by the handle of the scalpel or with the finger-nail, and pushed outwards, and the tendons of the extensor carpi radialis, longior and brevior, are cut through as they run inwards to their insertions. The trapezium is next to be separated from the rest of the carpus by means of the bone forceps.

The *ulnar incision*.—The knife is entered on the internal subcutaneous surface of the ulna, two inches above the joint, and carried obliquely downwards to the middle of the shaft of the fifth metacarpal bone, reaching its palmar aspect. The extensor carpi ulnaris is then cut at its insertion into the base of the fifth metacarpal bone, and now the handle of the knife may be passed beneath all the extensor tendons of the hand so as to clear the posterior surface of the carpal bones. The posterior and internal lateral ligament of the wrist are now exposed and may be divided. The joint being thus opened, the knife may be carried through the joint to the anterior surface of the ulna, and the soft tissues carefully separated from that surface of the bone; then the knife is turned and carried downwards to separate the pisiform bone from its articulation with the cuneiform, the bone not being removed, but allowed to remain attached to the tendon of the flexor carpi ulnaris. In cutting through the articulation of the pisiform the knife impinges upon the unciform process of the unciform bone, and this is better removed by the bone forceps. The anterior ligament of the wrist is next to be divided, and the bones of the carpus condyle on one side and from the internal condyle on the other, and prolonging them for about three inches upwards. (2.) By uniting these two incisions by a transverse one which divides the skin and the triceps muscle immediately above the olecranon a quadrilateral flap is obtained, which, after being raised from below upwards, is to be held by an assistant, *a* (Fig. 3). (3.) The bone is next to be carefully isolated from the surrounding tissues, especially from the ulnar nerve, which, having been disengaged from the bone, is to be drawn to one side by an assistant. (4.) The bone thus denuded a spatula may be inserted to protect the soft parts, while the diseased portion of bone is cut through with the ordinary saw, *c* (Fig. 3). Lastly, the fragment of bone is removed by cutting through in succession the adherent structures, and throwing open the joint from behind forwards.

II. *Resection of the upper extremity of the bones of the forearm.*

M. Moreau's plan may be made use of by prolonging the external lateral incisions along the radius as far as the point where the bone is to be excised. The radius is then to be separated from the ulna and the soft parts; a spatula or bandage applied in the usual manner; and the end of the radius excised, preserving, if possible, the insertion of the biceps.

If it is desired to remove the end of the ulna, it should be exposed in the same manner, by prolonging the internal lateral incision. Then proceed as with the radius, and if the operation permits of it, preserve the attachment of the brachialis anticus.

When it is necessary to remove the extremities of all the bones entering into the formation of the elbow joint, a single incision may be employed instead of those just indicated. This incision should be about five inches in length, extending longitudinally on the posterior aspect of the joint, its centre being at the olecranon process.

III. *Extirpation of the radius* (Plate XXXII., Fig. 5).

(1.) Make a longitudinal incision over the external anterior margin of the radius, *a*, *b*, cutting through the skin and soft parts so as to expose the bone. (2.) Then, having thoroughly denuded the bone, pass behind it a chain-saw, or, if any ordinary saw is to be used, a spatula, to protect the soft parts. (3.) Isolate the fragment of the radius, avoiding injury to the neighbouring vessels and nerves.

6. *Resection of the scapulo-humeral articulation.*

First by the simple incision.—A vertical incision is made along the anterior border of the deltoid, commencing below the coronoid process; then, at each angle of the deltoid incision, a transverse cut is made through the fibres of deltoid, but not including the integument, the object being to separate the lips of the wound, and to facilitate the opening of the capsule of the joint, without which the head of the bone cannot be drawn out.

M. Malgaigne's plan.—A similar vertical incision is made over the deltoid, but more externally than in the former operation. This incision will be opposite the apex of the coraco-clavicular triangle, by making it reach as far as that point. The skin, the muscles, and the capsule of the joint are divided down to the bone with one stroke of the knife; and then the joint is exposed had long suffered from necrosis of the external third of the clavicle. "I first," says M. Velpeau, "made a crucial incision, the two branches of which were each about four inches in length. Having dissected and reflected back the flaps, and divided the acromio-clavicular ligaments, and some of the fibres of origin of the deltoid and trapezius muscles, I was able, by the leverage afforded by a piece of wood thrust into the joint, to lift up the diseased bone and to detach it from the sound parts. In case too much force is used, we should be very careful to isolate the soft parts before and behind, to pass under the lower surface of the bone the chain-saw, and to cut it from behind, in order to disarticulate and remove it."

(*b.*) *Resection of the sternal end.*—In one instance M. Davie performed this operation by making an incision about three inches in length over the internal extremity of the clavicle, and in the axis of this bone. He divided the ligaments as far as possible ; then he excised with Scultet's saw the end of the bone to the extent of rather more than an inch from its articular surface, and, to avoid injuring the neighbouring parts, he passed a piece of hard leather beneath the bone while it was being excised. After the bone had been cut through, he was obliged, in order to raise the internal fragment, to break down with the handle of the scalpel, which he used as a lever, the inter-clavicular ligaments, which he had not been previously able to reach, and which still retained the bone in its place.

(*c.*) *Complete extraction of the clavicle.*—Mott, of New York, successfully performed this operation in a case of osoteo sarcoma. His operation was as follows: He made a curvilinear incision, with its convexity below, extending from one extremity of the bone to the other; he then made a second incision above, from the acromion to the external jugular vein, cut through the platysma and a portion of the trapezius, and passed beneath the bone close to the acromion a director which served as a guide for the chain-saw with which section of the clavicle was effected. The extraction of the ends of the bone was rendered difficult on account of the size of the tumour, and the deformity of the parts concerned.

To simplify this operation, MM. Valpeau and Malgaigne recommend that three incisions should be made, so as to form a quadrilateral flap with its base above, and which could be dissected and reflected back in that direction.

8. *Excision of the scapula.*

Janson excised a large part of the infra-spinous portion of the scapula, which was the seat of a tumour. Two elliptical incisions were made round the tumour, and the two lips of the wound dissected and reflected.

Then recognising that the supra-spinous portion of the scapula was sound, he separated with a saw all the diseased parts, thus preserving the use of the joint.

PLATE XXXIII.

RESECTIONS WHICH ARE PERFORMED ON THE LOWER EXTREMITY.

Fig. 1.—*Resection of the lower end of the fibula.*—The operator by means of a chisel, and a mallet, removes the external malleolus.

Fig. 2.—*Resection of the lower end of the tibia.*—*a*, a linen bandage for the purpose of raising the parts lying in front of the bone ; *b*, a piece of wood to keep back the soft parts behind, and protect them from the saw, *c*.

Fig. 3.—*Resection of the lower end of the femur.*—*a*, a split bandage for the same purpose as above mentioned ; *b*, piece of board protecting the soft parts behind from the saw, *d* ; *e*, lower end of the femur dislocated forwards.

Fig. 4.—*Resection of the head of the femur.*—*M. Sédillot's plan.*—*aa*, a semilunar incision, with its convexity above extending around the great trochanter ; *bb*, piece of board placed under the head of the dislocated femur ; *cc*, the chain-saw, excising the head of the bone from within, outwards.

STEPS OF THE OPERATIONS.

1. *Resection of the first metatarsal bone.*—The first metatarsal bone is the only one on which this operation is performed.

(1.) *Resection of the anterior extremity of the first metatarsal bone.*—M. Blaudin makes on the inside of the foot a quadrilateral flap with its base behind. The flap being dissected and the lips of the wound kept apart, the extensor tendon is drawn to one side ; then having opened the metatarso-phalangeal joint, the head of the bone is dislocated at the same time that the bistoury separates the soft parts on each side. The latter must be protected in the usual manner, while by means of a metacarpal saw, or, what is better, of the chain-saw, the diseased part is removed by sawing in a direction perpendicular to the axis of the bone.

The form of the incision can be modified according to the circumstance of the case. (2.) For the complete extraction of the first metatarsal bone, a quadrilateral flap is made as before, and reflected back as far as the level of the scaphoid bone, or a curved incision may be made, with the curve upwards, extending from the tarso-metatarsal to the metatarso-phalangeal joints. At first the metatarso-phalangeal joint should be operated on, as it is looser than the other, then, raising and drawing out the head of the bone, all the adherent structures should be cut through in succession, and the operation finished by opening the articulation of the metatarsal with the cuneiform bone. M. Velpeau prefers to saw through the middle of the bone with the chain-saw, and to extract the two halves separately.

2. *Excision and removal of the tarsal bones.*—The cuneiform and cuboid bones, and especially the astragalus and os calcis, have been removed or excised in certain cases of caries, dislocation, contusion, etc. ; but there are no fixed rules for the performance of these operations. They are subject to the very variable conditions under which the patient may be placed. In order to separate the bone, it is often necessary to use the gouge and mallet.

3. *Excision of the tibio-tarsal joint* (Plate XXXIII, Fig. 1,

be dissected and raised in order to isolate the tibia from the surrounding parts, avoiding injury to the tendons, vessels, and nerves; the extensor tendons, and the anterior tibial vessels are pushed forward, and the excision of the bone effected with a little straight-bladed saw, the soft tissues being protected by a thin wooden board. The chain-saw might also be advantageously used, as it could be inserted round the tibia without any risk of wounding the tendons, and would saw through the bone from behind forwards. After the tibia is excised, the upper surface of the astragalus may be sawn off if necessary.

3. *Extraction of the fibula.*—The operation is begun by exposing the middle of the bone for the purpose of dividing it with the chain-saw. Afterwards its upper and lower extremities are successively extracted. In some cases, moreover, merely a portion of the ends of the fragments may be excised without interfering with the joint.

4. *Excision of the femoro-tibial articulation* (Fig. 3).—*Syme's operation.*—(1.) The leg being fixed at a right angle upon the thigh, a curved incision, with its convexity above, is made above the knee-cap, extending from one lateral ligament to another, and at once laying open the joint. (2.) A second curved incision, with its convexity below, is thus made beneath the knee-cap, and joining the angle of the first, so that the knee-cap is enclosed within an elliptical flap, which is to be removed. The lateral and deep ligaments are then to be divided with the point of a knife, and the femur and tibia made to project, taking care that the soft parts are carefully detached from behind, and that the popliteal vessels are not wounded. During the excision of the ends of the bones, a piece of board must be applied behind them in the usual manner, and the soft parts further protected and raised by a bandage.

Moreau's plan for the excision of the knee is analagous to that for the elbow. He makes two lateral incisions up the thigh as far as the point where the bone is to be excised. These are united by a transverse incision passing below the knee-cap. After raising the quadrilateral flap the knee-cap is extirpated. The ends of the bones can then be easily exposed and excised.

5. *Resection of the hip-joint.*—*M. Velpeau's plan.*—By

making a semilunar incision from the antero-superior process of the ileum to the tuberosity of the ischium behind the joint, a large flap with its convexity below can be cut at the expense of the surrounding soft parts. Then raise the flap and divide the posterior half of the capsule of the joint at the same time that the thigh is adducted and flexed, in order to divide the inter-articular-ligament, to pass a knife between the head of the bone and the cotyloid cavity, and divide the remaining portion of the fibrous capsule. The head of the bone may then be drawn out and excised.

M. Sédillot's plan (Fig. 4).—He makes a semilunar flap with its convexity above, and embracing the great trochanter and penetrating as far as the joint. The head of the bone is then drawn out, and its excision accomplished by means of the chain-saw.

PLATE XXXIV.

RESECTION OF THE INFERIOR AND SUPERIOR MAXILLARY BONES.

Fig. 1.—*Resection, through the articulation, of half of the inferior maxilla.—M. Lisfranc's plan.*—*a*, *b*, *c*, superior quadrilateral flap thrown back ; *d*, the inferior maxilla sawn through near the symphysis of the chin ; *e*, the left half of the bone dislocated outwards ; *f*, the internal maxillary artery ; *g*, submaxillary gland.

Fig. 2.—*Resection of the middle half of the body of the inferior maxilla.—Dupuytren's plan.*—*a* and *b*, flaps made by a perpendicular incision running in the median line through the lower lip ; the surgeon placed behind the patient excises the bone, *d*, with a cock's crest saw, *c*.

Fig. 3.—*Removal of the superior maxillary bone.—M. Velpeau's plan.*—*a*, *b*, *c*, a superior flap thrown up; the superior maxilla, *d*, has been detached by means of a chisel and mallet, or bone forceps, and the surgeon with a bistoury, *e*, divides the adjoining soft parts.

Fig. 4.—*The preceding operation finished.*—*a*, *a*, *a*, row of twisted sutures.

METHODS OF OPERATING.

1. *Resection and complete extirpation of the superior maxillary bone.—Gensoul's plan, modified by Velpeau.*

The patient being seated upon a low chair, and his head kept slightly turned backwards, and supported against the chest of an assistant, a large incision with its convexity below is made upon the cheek, beginning at the commissure of the lips, and dissected outwards and then upwards as far as the temporal fossa. This large flap is then to be dissected from below upwards, and reflected upon the forehead. The maxillary bone being thus exposed, its connections with the other bones of the face are to be successively destroyed. (1) Divide with one blow of the chisel, or bone forceps, the external orbital apophyses on a level with the fronto-malar suture; (2) the zygomatic arch is treated likewise; (3) in the same manner the os unguis and the nasal process are separated; (4) all the soft parts which unite the ala nasi to the jaw-bone are to be dissected off, and the bone itself separated from its neighbour on the opposite side, either with the bone forceps, or with a little saw; (5) the soft parts are then to be detached from the floor of the orbit, carrying the chisel or forceps flat as deeply as possible into the floor, in order to make an oblique cut from above downwards, and from before backwards, and so to divide at one blow the superior maxillary nerve and the connections of the bone with the pterygoid process. Lastly, the operation is terminated by dividing with a bistoury, or curved scissors the velum palati, and the other soft parts which still fix the maxillary bone.

Instead of the integumental incision being made across the cheek, it may be made through the upper lip into the nostril, and then along the ala of the nose to the inner canthus of the orbit.

2. *Resection and removal of the inferior maxillary.—Resection*

point where it is proposed to make the excision, and the corresponding teeth are extracted in order to facilitate the action of the saw. To effect the excision of the bone, Dupuytren stands behind the patient, and operates with a small hand-saw ; but the chain-saw may be more advantageously used, and then it will not be necessary to pass behind the patient. The section being completed on both sides, the bone is to be seized with the left hand, while, with a blunt-pointed bistoury, carried from below upwards, the posterior surface of the bone is cleared by dividing in succession from left to right all the muscles that are attached to it. At the same time an assistant keeps the tongue out of reach of the bistoury by means of a spatula. In some cases the tongue, falling back, has produced suffocation ; but such an accident must be guarded against by keeping the head inclined forwards.

3. *Resection or disarticulation of one-half of the inferior maxilla.*

1. Make a horizontal incision along the inferior border of the jaw, and extending from the symphysis to the angle of the bone, and upon the two extremities of this incision let fall two vertical ones, of which let the internal one divide the inferior lip in the median line, while the external one commences at the zygomatic arch and passes behind the ramus of the jaw. There is thus formed a quadrilateral flap which is to be reflected from above downwards. Then cut through the bone in the middle, clean with the knife its posterior surface, and detach in succession all the soft parts as far as the angle of the jaw. On reaching the joint, insinuate behind the coronoid process below the zygomatic arch a button-end bistoury, which will serve to divide the temporal muscle, while at the same time the jaw is depressed in such a manner as to admit of its coronoid process being disengaged, and its condyle dislocated. Lastly, cut through the pterygoid muscle and the articular ligaments, and forcibly withdraw the bone, so as to detach the vessels of the ramus of the jaw, and avoid injuring the internal maxillary artery.

The whole or the half of the horizontal portion of the inferior maxilla may be removed, according to the extent of the disease.

The removal of the whole lower jaw has been successfully performed by Walther of Bonn.

RESECTION OF THE BONES OF THE TRUNK.

1. *Resection of the ribs.*—The patient lying in a convenient position, the affected ribs are exposed by incisions of a length proportionate to the extent of diseased bone. Having thus marked out the limits of the section, a cock's crest saw or a Heine's saw should be used. In all cases, however, the pleura should be previously separated from the internal surface of the rib with the end of a director and a bandage passed beneath the bone. After the rib has been divided, it should be raised with a soft elevator, and the intercostal muscles carefully divided and cleared from the border of the bone, so as to avoid injuring the intercostal artery or the pleura.

2. *Resection of the sternum.*—This is usually effected by the combined operations of trepanning and resection. We cannot beforehand lay down rules for this operation, considering the various pathological conditions in which it may be required. The essential point is to avoid the mammary vessels on the

PLATE XXXV.

TREPANNING OF THE CRANIAL BONES.

ANATOMY.

Fig. 1.—*A vertical and antero-posterior section of the cranium.*—A view of the cerebral hemisphere covered with its membranes, in order to show the position of the middle meningeal artery and the sinuses of the dura-mater.

a, a, a, branches of the middle meningeal artery.—This artery enters the interior of the cranium by the foramen spinosum Its anterior branch, which is the largest, furrows the anterior and inferior angle of the parietal bone, half its diameter being lodged in a groove in the bone. It is often entirely embedded in the bone, and only comes in contact with the dura-mater after it has run through an osseous canal of considerable extent. The posterior branch, which is not so large, runs over the squamous portion of the temporal bone. It is above the level of the anterior and inferior angle of the parietal bone that an injury to the middle meningeal artery is to be feared.

b, b, b.—The course of the superior longitudinal sinus.—This sinus is lodged between the two cerebral hemispheres, and is formed by the doubling in of the falx cerebri, of which it is a process. It is not placed in any groove in the bone except behind for about a fifth part of its length. Beginning at the crista galli of the ethmoid bone, it terminates at the internal occipital protuberance cn a level with the torcular herophili.

d. The right lateral sinus.—The lateral sinuses are lodged for about half their diameter in a groove which separates the superior from the inferior occipital fossæ. They begin at the internal protuberance, and are directed horizontally towards the petrous portion of the temporal bone. They are situated superficially to the extent only of two and a half inches. They turn inwards and downwards to empty themselves at the posterior lacerated foramen.

Fig. 2.—*Application of the trepan.*—*a, a, a, a,* the four flaps resulting from a crucial incision into the integuments ; *b*, the trepan in the act of being applied.

Fig. 3.—*Excision by means of clippers.*— *a*, removal of the angular pieces of bone left.

Fig. 4.—*The operator armed with a lenticular knife, a*, levels the edges of the wound in the bone.

METHOD OF OPERATING.

The patient should be lying down, and his head, resting on a board furnished with a cushion, should be kept in position by assistants. The surgeon should then make a V or a T shaped, or a crucial incision through the integuments; and the flaps should be dissected and reflected back. The periosteum should be raised before applying the drill trepan, or the French trepan, or, still better, the English trephine. If the trepan is used, it should be furnished with a perforator; then holding it in the right hand like a pen, the point of the perforator is to be applied to the denuded bone, the ebony plate which surmounts the trepan being held between the thumb and the index finger of the left hand at the same time that the chin is pressed against moved alternately from right to left and from left to right, and with an amount of pressure that is sufficient to make an impression upon the bone. The perforator is then to be raised and the operation continued until the perforation of the bone is complete, observing the same rules that regulate the use of the French trepan.

When it is desirable to apply the trepan more than once, the points should be at some distance from each other, while the intervening portions of bone may be removed with the cock's crest saw. Or the crowns of the trepan may be applied in such a manner that they encroach one upon the other, the angles of bone which intervene between them being removed with the cutting forceps. If we wish to raise by means of this operation pieces of depressed bone, an elevator should be applied between the cranium and the dura-mater without disturbing this membrane. If it is necessary to let out fluid effused beneath the dura-mater, a longitudinal or crucial incision should be made with a bistoury.

OPERATIONS WHICH ARE PERFORMED UPON THE ORGAN OF VISION.

OPERATIONS UPON THE EYELIDS.

ANATOMY.—THE EYELIDS.

The following elements partly enter into the structure of the eyelids.

1. *The skin*, which is delicate, soft, elastic, and loosely united to the subjacent tissues.

2. *A layer of cellular tissue*, uniting the skin to the muscular layer. This tissue, being very loose, is favourable to the development of encysted tumours. It is often the seat of serous infiltrations and erysipelatous inflammation, and which subsequently give rise to traumatic lesions of the eyelids and face.

3. *The muscular layer*, composed of the most central fibres of the orbicularis palpebrarum, and forming thin pale arches over the eyelids, which are not connected at the external commissure. The upper eyelid has also its own muscle, the levator

palpebræ superioris, which is situated behind the orbicular muscle. This muscle takes origin within the orbit, and is attached to the tarsal cartilage by a thin aponeurosis. It receives its nervous filaments from a fasciculus of the third nerve, and it regulates the elevating movements of the upper eyelid, whilst the action of closing the lid is under the influence of the facial nerve. It is to paralysis of this muscle that blepharoptosis is for the most part due.

4. *The tarsal cartilages*, situated behind the muscular layer, and consisting of small fibrous lamellæ, constitute as it were the skeletons of the lids, which maintain them in their proper form and position. The cartilage of the upper lid is about double the depth of that of the lower one. Both are united internally and externally by a palpebral ligament, with which is connected the orbital aponeurosis.

5. *The Meibomian glands* are situated between the tarsal cartilages and the conjunctiva. They open by minute ducts on the face and border of the eyelids. Their hypertrophy gives rise to very small tumours, which are frequently noticed on the conjunctiva.

PLATE XXXVI.

OPERATIONS UPON THE EYELIDS.

Fig. 1.—*Symblepharon.—Ammon's method.*—The portion of eyelid which adheres to the globe of the eye is enclosed between two incisions, *a*, *b*, and *c*, *b*, which isolate it from the rest of the eyelid.

Fig. 2.—*Same operation finished.*—The two free edges of the incision are united by three sutures, the little adherent triangular, flap, *a*.

Fig. 3.—*Epicanthus.*—*a*, *b*, *c*, *d*, an elliptical wound, resulting from the excision of a fold of skin taken from the root of the nose.

Fig. 4.—*Blepharoptosis.—Ordinary operation.*—*a*, pressure or cross action forceps seizing a fold of skin, *b*, on the upper eyelid, which is excised with the scissors, *c*.

Fig. 5.—*Same operation.—Hunt's plan.*—*a*, *b*, *c*, form and position of the flap that is removed. Fig. 5.—*bis*, the operation completed. The edges of the wound are brought together with the twisted suture.

Fig. 6.—*Entropion.—M. Janson's plan.*—The surgeon seizes with Adams's forceps a vertical fold of skin, and excises it with the curved scissors, *b*; *c*, *d*, the same operation finished near the external angle of the eye; the edges of the wound are united by three twisted sutures.

Fig. 7.—*Entropion.—Crampton's method modified by that of Guthrie.*—*a* and *b*, vertical incisions carried through the whole thickness of the lid; *c*, *d*, transverse incision through only half the thickness of the lid. The edges of this incision are brought together with the sutures, *e*, *e*, *e*, *e*; a piece of plaster, *ff*, retaining the threads on a level with the eyebrow.

Fig. 8.—*Ectropion.—Adams's operation.*—*a*, first incision made into the lower lid; the surgeon seizes the edge of the lid outside that incision with the forceps, *b*, and with the scissors, *c*, cuts a small triangular flap.

Fig. 9.—*Same operation—Dieffenbach's plan.*—*a*, *b*, incision made in the lower lid; the surgeon with the forceps, *c*, draws the conjunctiva into this incision, and excises it with the scissors.

PLATE XXXVII.

FURTHER OPERATIONS PERFORMED ON THE EYELIDS.

Fig. 1.—*Ectropion—M. Desmarres's operation.*—*a, b,* first incision beginning at the external angle of the eye ; *b, c,* second incision beginning at the free border of the lower lid and joining the first at *b ; c, d,* and *a, d,* two incisions beginning at the internal extremities of the two first, and meeting at *d,* at the point of reflection of the ocular and palpebral mucous membranes.

Fig. 2.—*Same operation finished.*—Three sutures, *a, a, a,* uniting the edges of the wound.

Fig. 3.—*Blepharoplasty.—Jones's plan.—Operation finished.*—*a, b, c,* triangular flap replaced for the purpose of covering the denuded surface ; *c, d,* approximation of the integuments in order to fill up the wound which the removal of the flap has left behind.

METHODS OF OPERATING.

Coloboma.

Coloboma is a congenital or accidental division of the whole thickness of the eyelid. If the division is congenital, the edges should be pared, and afterwards brought together by means of two or three twisted sutures. If, on the other hand, it is accidental and recent, the bleeding edges of the wound should be approximated in a similar manner. The pins should be applied at a distance from the free border of the lids; they should pierce the skin and the tarsal cartilages, without, however extending through the whole thickness of the lid, so as to avoid the inflammation which would arise from their contact with the globe of the eye.

Ankyloblepharon.

Ankyloblepharon, or adhesion of the lids together at their free borders is rarely congenital. It is a frequent result of ulceration of the edges, and may be either partial or complete. If it be partial, we can, according to the extent of the adhesion, divide it either with the blunt-pointed scissors, or with a bistoury guided by a director introduced between the eye and the lids. If the adhesion is entire, we must first make a small opening at the external angle of the eye, between the two lids, and then insert into the aperture a director, which will guide the bistoury in the division of the adherent parts.

In all cases we must, before operating, be sure that the lids are not adherent to the globe of the eye. If there are any fibrous bands uniting the palpebral mucous membrane to the eye, they must be previously broken down with the stylet. Directly the operation is completed, it will be necessary to prevent the formation of fresh adhesions. For this purpose we should use an astringent lotion, place some foreign body between the edges of the lids, forcibly separate them by means of adhesive bands, cauterise them with nitrate of silver, etc. If adhesions form in spite of these measures, the cicatricial tissue must be daily destroyed. M. d'Ammon has also proposed to dissect a flap from the conjunctiva, and to fix it upon the wound.

Symblepharon.

Symblepharon, or the adhesion of the lids to the globe of the eye, is very rarely congenital. On the other hand, it is a frequent result of inflammation with loss of tissue, attacking the palpebral or ocular conjunctiva. The affection consists of fibrous bands, more or less approximated, which unite the palpebral mucous coat to the globe of the eye. These bands restrain the movement of the globe, and consequently it is necessary to divide them. If they are isolated, as in the bridle form, they can be cut with small curved blunt-pointed scissors. To prevent fresh adhesions, we must prevent the parallelism of the two little wounds resulting from the division of the bands by drawing the lid outwards by means of an adhesive fillet or band. When the symblepharon consists of numerous serrated bands, rendering the eye immovable, recourse must be had to the following operations :—

M. d'Ammon's operation (Plate XXXVI., figs. 1, 2) *for continuous adhesions.*—He encloses within two incisions, *c*, *b*, and *a*, *b*, carried through the whole thickness of the lid, that portion of it which is adherent to the globe of the eye. As soon as this upon the inner angle of the eye (see Plate XXXVI., fig. 3). To correct this fault, a vertical fold of skin should be seized internally, and on a level with the epicanthus, at the expense of the skin of the nose. The effect of making this fold is to uncover the angle of the eye by dragging inwards the epicanthus which conceals it. The fold of skin is excised with one cut of the curved scissors. The edges of the oval wound thus produced are then brought together with sutures with the effect of removing the epicanthus. If the epicanthus is double it will be convenient to take a fold of skin between the eyes from the middle of the nose in order to remedy the affection on both sides by one operation.

Blepharoptosis (Plate XXXVI., figs. 4, 5, & 5 *bis*).

. Blepharoptosis, Ptosis, Blepharoplegia, is the falling of the upper eyelid. It may arise from an elongation of the integuments, or from more or less complete paralysis of the elevator of the upper lid. The surgical treatment consists in removing the exuberant part of the lid.

Ordinary operation (fig. 4).—Seize with the pressure or cross action forceps, *a*, a transverse fold of skin, *b*, on the upper lid. The great point is to make the fold of skin of sufficient size to admit of the lid, when lowered, covering the globe of the eye. If it is made too short, a second operation will be necessary; if too long, it may lead to the formation of an entropion. The fold of skin should be excised with the scissors, *c*, the result of which is an elliptical wound, the edges of which must be brought together with two or three sutures. Some surgeons pass threads through the fold which has been seized by the forceps, and then excise it in front of the threads which are thus already in place for uniting the edges of the wound. This practice has the advantage of shortening the operation, and making it less painful.

It is recommended that the skin be removed in such a position as to take advantage of the action of the occipito-frontalis or supra-ciliary muscle.

Hunt's method (fig. 5 and 5 *bis*).—Having shaved the eyebrow, remove a semi-elliptical flap, *a*, *b*, *c*, the size of which should be in proportion to the extent to which the eyelid is relaxed, and bring together the edges of the wound in the usual manner. By this means the upper lid is elevated (see fig. 5 *bis*). The cicatrix of the wound is concealed by the eyebrow.

M. Sédillot has proposed to utilise the supraciliary muscle by dissecting its external insertion, which he causes to descend into the eyelid. By this means he would put the movement of the lid under the influence of those of the supraciliary muscle.

Entropion.

Entropion is an affection characterised by a turning inwards of the eyelids.

The indications for the surgical treatment of entropion must depend upon the nature of the causes producing it. Amongst these we may mention faulty conformations of the skin, or of the palpebral mucous membrane, contraction of the orbicularis palpebrarum, alterations of the tarsal cartilages, etc.

Entropion arising from relaxation of the skin or from spasmodic contractions of the orbicularis may be successfully treated ing. A drop of the acid is then to be spread transversely over the lid, with a glass rod.

After the acid has been allowed to remain on the lid for ten or fifteen seconds, it is to be wiped off. If the entropion is not corrected by this first cauterisation, several other applications of the acid may be made until the lid has assumed its normal position. It sometimes happens that the operation is carried too far, and that the entropion is followed by an eversion in the opposite direction. This risk is to be avoided by attaching the eyelashes to a thread fixed to the cheek for the upper lid, and to the forehead for the lower lid.

Excision of the skin, as proposed by Celsus.—This method is adopted in the graver forms of entropion ; and consists in excising a transverse fold of skin, the size of which should be proportionate to the degree of inversion. The operations described under blepharoptosis (see Plate XXXVI., fig. 4, 5, and 5 *bis*) are applicable to entropion.

Janson's method (see Plate XXXVI., fig. 6)—In place of removing a horizontal fold of skin, he seizes with Adams's forceps, *a*, a vertical fold, which he then excises with the curved scissors, *b*. The edges of the wound are brought together, with threads passed through the fold of skin previously to its excision, or by means of the twisted suture, *c*, *d*. Sometimes the excision of one fold is not sufficient, and it is necessary to remove two or three.

Haynes Walton dissects off with the scalpel the ciliary portion of the orbicularis muscle which lies on the edge of the eyelid, together with that amount of skin which covers the muscle, and unites the wound by sutures.

Crampton's operation modified by Guthrie (see Plate XXXVI., fig. 7).—This operation is chiefly applicable to entropions arising from a faulty condition of the tarsal cartilage ; and is performed in the following manner :—The surgeon makes with the straight scissors a vertical incision right through the lid a little to the outside of the puncta lacrymalis. A similar incision, *b*, is made near the external angle ; the enclosed flap is raised, and the two incisions united by a transverse one through the mucous membrane only. The flap is then let down, a small transverse fold of skin, *c*, *d*, is cut from the cutaneous surface of the lid, and the threads, *e*, *e*, *e*, *e*, passed through the edges of the wounds to bring them together, and fastened to the forehead, *f*, *f*. This operation, which is both painful and difficult of execution, leaves behind a deformity of the lid which has led to its abandonment.

Saunders's plan.—This consists in the removal of the tarsal cartilage. Having introduced beneath the lid one of Beer's plates, an incision is made from one angle to the other parallel with the palpebral edge, and two or three lines from the roots of the lashes. The skin is then to be dissected as far as the orbital border of the cartilage, which is to be seized with the forceps, detached from the conjunction and removed.

Trichiasis.

Trichiasis, or inversion of the eyelashes against the globe of the eye, differs from entropion in that the tarsal cartilage maintains its proper position. It may arise either from a malposition of the lashes or from the abnormal manner in which they are fix the affected lashes with a thread, restoring, and temporarily keeping them in their normal position by attaching the thread to the adjoining parts by means of a small piece of adhesive plaster. This proceeding, however, is only applicable to partial trichiasis.

Extirpation may be practised with or without cauterisation. Extirpation should be effected by removing with the hair forceps each individual lash. It is often necessary to repeat the operation, and it is to prevent the lashes from budding out afresh that cauterisation is also resorted to. M. Champmesme uses a small cautery at the end of which is a bulb, surmounted by a fine needle. The bulb, or reservoir of heat, is heated to a white heat, and the point of the needle is then introduced into each bulb of the lash. But this is a long, painful, and difficult operation. M. Carron du Villars prefers introducing into each hair bulb a long cold needle, and when the needles are all fixed, they are united into a bundle and seized with a curling iron, which is raised to a white heat. Heat is thus suddenly communicated to the needles, and all the bulbs are cauterised at once.

To extirpate the bulbs, as proposed by Vacca-Berlinghieri, a plate of ivory is introduced beneath the lid, an incision made parallel to its margin, according to the extent of the trichiasis. Two small vertical incisions are then made from the extremities of the first incision, so as to permit of a small flap of skin to be raised behind which the bulbs are brought into view, and dissected out one by one. M. Petrequin, of Lyons, removes the small flap of skin, and when cicatrisation has taken place, the border of the lid is restored to its proper condition.

Excision of the margin of the lid is done with scissors, taking care to spare the punctum lacrymale. Partial trichiasis may also be treated, after Schreger, by the excision of a small V-shaped flap, just as Adams operates for ectropion.

Ectropion (Pl. XXXVI., figs. 8--9, & Pl. XXXVII., figs. 1—2).

Ectropion or retroversion of the lids, is often produced by the same causes as those which give rise to entropion.

Diseases of the conjunctiva, deformities of the tarsal cartilage, a shrinking of the skin or affections which cause it, disease of the orbicular muscle, caries of the edge of the orbit, etc., are so many causes producing different varieties of ectropion, for each of which special treatment is required.

Ectropion occasioned by diseases of the conjunctiva.—If acute inflammation of the conjunctiva has caused a temporary tumefaction, the ectropion thus produced may be combatted by scarifications, or by the application of lunar caustic. But if in consequence of this inflammation the conjunctiva is hypertrophic and the seat of fungous granulations, cauterisation will then be insufficient, and it will be necessary to excise the swelling formed by the diseased membrane. The excision is effected by seizing the conjunctiva with the forceps or hook, and cutting off the exuberant part with the curved scissors. Care must be taken not to remove too much tissue, otherwise entropion will result. The lid is then drawn up and kept in contact with the globe of the eye by means of a bandage.

Antyllus removed from the diseased mucous membrane a triangular flap, the base of which was turned towards the free border of the lid ; but this plan has no advantage over the one above described.

M. Desmarres's operation (see Plate XXXVII., figs. 1 & 2).—M. Desmarres, wishing to avoid the visible and objectionable cicatrix which is always left after Adams's operation, adopts the following method:—One horizontal incision, *a*, *b*, is made from the external angle of the eye; and a second, *c*, *b*, commencing at the free border of the retroverted lid, meets the first incision at *b*. Two other incisions, *a*, *d*, *c*, *d*, describe on the conjunctiva a small triangular flap, the base of which coincides with the base of the first flap, *a*, *b*, *c*; the tissues enclosed within these incisions are then excised, while the two edges of the wound, *a*, *b*, and *c*, *b*, are united by means of sutures, fig. 2, *a*, *a*, *a*; the resulting cicatrix is hid in the folds of the external angle of the eye.

Ectropion caused by elongation and malformation of the tarsal cartilage.—This is to be remedied by excising the cartilage. Weller first removes the fungous growths which cover the conjunctiva, and then excises about the twelfth or sixth of an inch of the tarsal cartilage, taking care to spare the external ridge of the border of the lid. The wound is then allowed to heal of itself.

Under the name of *tarsoraphy*, Walther has described a method which consists in removing within the same triangular flap the two external ends of the cartilages. The base of the flap embraces all the external angle of the eye, while the apex points towards the temple. The lips of the wound are then united by means of several twisted sutures.

Ectropion from contraction of the skin.—The cicatrisation of burns and wounds which are attended with loss of substance, is the most frequent cause of this variety of ectropion. In some cases we may resort to Adams's operation (Pl. XXXVI., fig. 8), taking care to prolong one of the incisions beyond the summit of the triangle.

If the cicatricial bridles are of small extent and have not contracted adhesions to the adjacent bones, we may cut them through transversely, and enlarge the space occupied by the cicatrisation, by keeping apart the lips of the wound by means of adhesive plaster, or we may prevent immediate union by the interposition of some foreign body, or we may follow the recommendation of M. Amussat and destroy daily the cicatricial tissue as fast as it forms at the bottom of the wound.

Should the cicatrix adhere to the ridge of the orbit, we must enclose it between two incisions, dissect freely the lips of the wound, and bring them forwards over the cicatrix on the bone.

This operation has been successfully performed by MM. d'Ammon and Desmarres.

When the cicatrices are too extensive to admit of our adopting the above measures, we must have recourse to blephoraplasty (see Pl. XXXVII., fig. 3, 4, 5, 6).

The *affections of the orbicularis palpebrarum* which give rise to ectropion are: spasmodic contraction and displacement of the fibres of the muscle. In the first case the usual medical treatment should be adopted. If that fail, we must cut across the fibres of the muscle beyond the part which adheres to the cartilage. In the latter case M. Desmarres strongly recommends cauterisation with sulphuric acid, or the excision of a cutaneous fold near the ciliary margin of the lids. By this means the fibres which are averted from the free border of the tarsal cartilage would be liberated.

Incision combined with the application of the nitrate of silver is more efficacious, as then adhesive inflammation is set up in the walls of the cyst.

In order to cut into and excise the cysts from the conjunctiva, an assistant keeps with his fingers or with smooth-bite forceps the lid retroverted over a small rod, or other support (see Plate XXXVIII., fig. 8). The surgeon, with a pair of forceps and a small bistoury, makes an incision into the conjunctiva which should pass a little to the right and left of the tumour, and then the cyst may be dissected and raised without being opened. To remove these cysts from the anterior surface of the lids, the lid is to be held between the fingers, and the dissection proceeded with as above described In all cases the tumour should be cautiously isolated from the tarsal cartilage.

Desmarres's operation (Plate XXXVII., fig. 7).—This has the advantage of being more easy, by tensing the lid, and stopping the hæmorrhage by maintaining pressure all round the tumour. A pair of annular forceps, one branch of which ends in a plate and the other in a ring, takes hold of the lid. The ring in being pressed towards the plate presses around the tumour so as to stop the hæmorrhage. The forceps is entrusted to an assistant, and the surgeon dissects out the tumour in the manner already described.

II. *Chalazion* is a small, indolent, and slightly movable tumour, occupying the free border of the lids. It is not unusual to meet with a series of them, forming a chaplet from one corner of the eye to another. They should be treated in the same manner as other encysted tumours.

III. *Erectile tumours.*—Compression, the ligature, and cauterisation can be successfully employed in these cases. The form and extent of the tumour will show what means should be adopted. For cauterisation, Carron du Villars transfixes the tumour with several needles, which he unites to a metallic ball. The ball is heated to whiteness and the cauterisation is followed by suppuration, which destroys the tumour.

IV. *Cancerous tumours.*—The excision of these tumours cannot be submitted to any particular rule. They may be enclosed between two curved incisions or two incisions in the shape of a V.

The lips of the wound may then be brought together with sutures, provided its extent and form permit of it.

V. Encanthis, or tumour of the caruncula lachrymalis, may be treated by cauterisation, or it may be extirpated. The latter method is to be preferred. By means of a hook, or the forceps, the tumour is drawn outwards, and is then excised either with the bistoury or the curved scissors.

Blepharoplasty (Plate XXXVII., fig. 3, 4, 5, 6).

This operation is one by which we repair, at the expense of the adjoining parts, eyelids which have undergone a partial or total loss of substance.

The measures which have been adopted in order to attain this object may be arranged under the three following methods: that of extension, that of displacement, or inclination (the French method), and that of torsion of the flaps (Indian method).

1. *Operation by extension.*—Jones's operation (Plate XXXVII., fig. 3).—Having pared the edges surrounding the lost substance, two incisions, *a*, *d*, and *b*, *d*, are to be made, beginning at the

3. *Operation by torsion of the flap* (Græfe & Fricke, figs. 5, 6).—The morbid cicatrices may be removed by two incisions which enclose an elliptical wound, *a*, *b*, *c*, *d*. A flap is then cut at the expense of the fronto-temporal region of the upper lid; and of the cheek for the lower lid. This flap should be of the same shape as the wound, and nearly a quarter of an inch larger than it. It is cut by making from the point, *c*, an incision which must be carried as far as *e*, *f*, and brought back on a level with and outside the point, *c*. The flap, having been carefully dissected, must be twisted on its pedicle in order to place it horizontally on *a*, *b*, *c*, *d*, where it should be fastened by the sutures, *a*, *a*, *a* (fig. 6). The edges of the artificial wound may then be brought together with the twisted suture.

PLATE XXXVIII.

OPERATIONS ON THE LACHRYMAL APPARATUS.

ANATOMY.

Fig. 1.—Vertical antero-posterior section, showing the relations of the nasal fossæ, the mouth, and the pharynx.—a. the inferior turbinated bone; *b,* Laforest's probe introduced into the nasal passage through the inferior meatus; *c,* Belloc's sound for plugging the nasal fossæ; *d,* Deleau's probe introduced into the Eustachian tube, *e; f,* probe introduced into the internal orifice of Steno's duct.

Fig. 2.—Anatomy of the lachrymal apparatus.—This consists of the lachrymal gland and its excretory ducts, the lachrymal ducts, the lachrymal sac, and the nasal duct.

The lachrymal gland is composed of two distinct portions, one overlapping the other. The larger or orbital portion is placed in the hollow on the inner side of the external angular process of the catheterism, their angular direction should be borne in mind. Taking their departure from the puncta, they extend perpendicularly (the upper one upwards, and the other downwards) into the lid. After a short course of about the twelfth of an inch, they suddenly bend, the upper one being directed inwards, and a little obliquely from above downwards ; and the lower one in the same direction, but from below upwards. The lachrymal ducts thus meeting each other often open into the lachrymal sac by a common duct, but more frequently they are separated by a partition. Their texture is loose, and by means of slight tractions made externally over the borders of the lids, we may make their curved form sufficiently straight to admit of our introducing straight probes. Their calibre, which is considerably greater than that of the puncta lacrymalia, is maintained by the elasticity of its walls.

The *lachrymal sac, d*, and the *nasal duct* form, by their union, one channel through which the tears flow into the inferior meatus, below the inferior turbinated bone. The sac which constitutes its upper portion consists of a small oblong and vertical reservoir, into which the lachrymal ducts open. Terminated above by a cul-de-sac, it is continuous below with the nasal duct. It is lodged in an osseous groove formed behind and within by the approximation of the os unguis, with the nasal process of the superior maxilla and inferior turbinated bone. Its external half is membranous, and is covered by the tendon of the orbicular muscle, which the lachrymal sac causes to jut out both above and below. This relation is of some importance, the tendon of the above muscle serving as a guide in penetrating the lachrymal sac. The insertion, however, of this tendon is subject to variations, so that the surgeon is sometimes obliged to have recourse to other data. The upper orifice of the nasal duct is found behind the osseous ridge, which is met with on the inside of the base of the orbit, when following with the finger, from without inwards, the inferior orbital ridge. This bony projection, which limits the lachrymal groove below, is the most reliable landmark.

The *nasal duct*, which is a continuation of the lachrymal sac, is formed, as regards its bony portion, in front by the nasal process of the maxillary bone, on the inside and behind by the os unguis and the small process of the inferior turbinated bone, and on the outside by the internal wall of the antrum Highmorianum. We can, therefore, through the posterior wall of the nasal duct, reach either the nasal fossæ or the antrum.

The length of the duct varies from two-thirds to four-fifths of an inch ; its upper orifice is elliptical from behind forwards, and its diameter in the same direction may be over a quarter of an inch. The lower orifice, situated beneath the inferior turbinated bone, is wedge-shaped from within outwards, at the expense of the external wall of the nose. In front it is provided with a small valve, which is often sufficiently developed to prevent the introduction of instruments, except from behind forwards.

Fig. 3.—*Catheterism of the lachrymal passages through the upper punctum lacrymale.*—*a*, Mejean's probe ; *b*, Seton.

PLATE XXXIX.

OPERATIONS WHICH ARE PERFORMED ON THE LACHRYMAL APPARATUS (*Continued*).

Fig. 1.—*Catheterism of the lachrymal passages through the lower orifice of the nasal duct.—Laforest's method.*—*a*, first position of the catheter; *b*, second position; the back of the instrument is inserted in the lower orifice of the nasal duct; *c*, third position of the catheter introduced into the nasal duct.

Fig. 2.—*Temporary dilatation of the lachrymal passages.—J. L. Petit's method, modified by Desmarres.*—*a*, the fingers of an assistant pulling the external angle of the lids in order to make prominent the tendon of the orbicularis palpebrarum; while the surgeon punctures the lachrymal sac with the bistoury, *b*, and introduces into the orifice the probe, *c*.

Fig. 3.—*Third step of the operation.*—A grooved director, *a* is inserted into the lachrymal duct, and serves to introduce the piece of cat-gut, *a*, by which temporary dilatation is to be effected.

Fig. 4.—*Permanent dilatation—introduction of the canula.*—The duct opened by the bistoury, *a*, which presses against the posterior lip of the wound. The surgeon introduces the canula, *b*, with the assistance of mandrel forceps.

LACHRYMAL TUMOUR AND FISTULA.

STEPS OF THE OPERATIONS.

The different affections to which the lachrymal apparatus is exposed may cause a mechanical stoppage of the tears, or give rise to an accumulation of fluid in the lachrymal sac, which distends it and produces a *lachrymal* tumour.

If the tumour is not removed by appropriate treatment, it increases in size, the skin inflames, ulceration takes place, and the fluid contained inside the sac runs out through a false passage, and gives rise to a *lachrymal fistula.* In the surgical treatment of these affections we endeavour to fulfil one of the three following intentions :—1. The re-establishment of the natural passage for the tears. 2. The production of new channels. 3. The obliteration of the natural channels.

1. *The re-establishment of the natural passages.*

The means employed for this purpose are: injections, catheterism, dilatation, and cauterisation.

1. *Injections.* — Often employed with success in cases of obstruction, injections at the same time permit of our conveying into the lachrymal ducts medicated fluids. An Anel's syringe is used for the purpose. The patient being seated in a chair, with his head kept in position by an assistant, the surgeon places himself in front of him, holding the syringe in his right hand for operating upon the left eye, and (unless he is ambidextrous) standing behind the patient, when operating on the right eye. The fingers of the other hand should gently evert the lower lid, so as to project forward the orifice of the inferior punctum lachrymale, which is to be chosen because it is shorter and larger than the upper one. The end of the syringe should be introduced perpendicularly to the palpebral border. It often happens that the punctum contracts, and prevents the introduction

that of the nasal duct. The patient being seated, an assistant keeps the head in a firm position, and a little inclined backwards. The surgeon then introduces the end of the sound underneath the nostril in such a manner that it can be passed beneath the inferior turbinated bone of the nasal fossæ, by giving to the instrument a rotatory movement (see Pl. XXXIX., fig. 1 *a*). The effect of this rotatory movement is to engage the end of the sound in the lower orifice of the nasal duct ; an operation which is carried out by gentle to-and-fro movements, for it is always from behind forwards that we must enter the inferior orifice; *b* represents the second position of the sound. In order to make it enter the nasal duct, it is necessary to give the instrument a half turn, by which means its curve is carried inwards and downwards (*c*). Directly this third step in the operation is accomplished the sound easily reaches the lachrymal sac. Plain sounds are sufficient to remove obstructions, but once the passage is free, we must have recourse to the hollow sounds of Gensoul, with which it is easy to use injections from below upwards.

3. *Dilatation.—Mejean's operation.*—This consists in performing catheterism through the superior lachrymal punctum with a probe whose upper end is perforated and threaded with silk. The probe passes through the nasal duct as far as the inferior meatus, carrying the thread with it. Or the eyelet end of the probe may be introduced, and then, when this end has cleared the nasal fossæ, the thread may be passed and drawn through (see Pl. XXXVIII., fig. 3). By this means the lachrymal puncta will be less frayed.

4. *Dilatation by an artificial opening.—J. L. Petit* makes at first an incision into the lachrymal sac for the purpose of introducing the foreign bodies that are intended to dilate the duct. He uses a grooved bistoury, over which he passes every day into the duct a different bougie. The external wound soon heals up. *Scarpa* uses a leaden style.

Lecat opened the sac in the same manner, but in place of using a bougie, or any other solid body, he inserted in the lachrymal passages a thread, by means of which he lifted up a tent into the nasal duct. This method does not differ from that of Mejean, except that the artificial opening facilitates the passage of the thread.

Pouteau, in order to spare the patient the disfigurement of a cicatrix, enters the sac from the internal surface of the lid.

Jurine introduced at first a canula, in which he placed a curved probe, passing it out by the nostrils and carrying with it the thread to draw up the tent.

Pamard passed into the canula the spring of a watch, which in virtue of its elasticity passes outside the nostrils and then recoils upwards with the thread to which the tent is fixed.

Fournier fastened to the thread a grain of lead for the purpose of drawing it outside.

Cabanis laid hold of Mejean's probe previously introduced into the lachrymal passages by passing beneath the turbinated bone a plate with a hole in it, and with which he seized the lower end of the probe. A second plate, gliding upon the first, nips the end of the instrument, which is then easily drawn out.

M. Manec introduces into the nasal duct, from below upwards, a sound provided with a sharp point. The sharp point pushed orbicularis muscle, as this tendon is a guide in finding out the upper orifice of the nasal duct (see Anatomical Indications). The bistoury being held in the right hand, the little finger of which rests upon the malar bone, is plunged into the lachrymal sac from before backwards in the direction of the os unguis; then the handle of the instrument, being depressed a little inwards and backwards, until it nearly touches the eyebrows, the blade is made to penetrate about two or three lines into the lachrymal sac and the nasal duct.

If there has been previously a fistulous opening a little distance off, the incision should be carried up to it in order to completely divide the fistulous tract.

Second step.—Introduction of a probe, over which is passed a hollow sound.—The bistoury is half withdrawn, and along its blade a probe passed and thrust into the nasal duct (fig. 2). This probe serves the purpose of conducting a grooved sound.

Third step.—Introduction of the cat-gut cord (fig. 3).—The sound being inserted in the nasal duct, the cat-gut cord, which is to effect the dilatation, is passed through the sound, which is afterwards withdrawn. This cord presents above two small wings, as it were, which prevent it from falling into the nasal duct. It should be changed every day for one of larger size, and soon Scarpa's style may be substituted for it. The introduction of the cord is often followed by a pretty active inflammatory reaction, occasioned by the swelling of the cord in the interior of the duct. It is therefore necessary to withdraw it at the end of twenty-four hours, and to introduce a very fine Scarpa's style, which can be every day replaced by other nails which gradually increase in size.

5. *Permanent dilatation.—Introduction of a permanent canula.*—Vesalius was the first to apply the canula to the treatment of lachrymal affections. This method, revived a long time afterwards by Foubert, Wathen, and Pellier, has been adopted and modified by Dupuytren. Dupuytren's operation consists of two stages: puncture of the sac and introduction of the canula. The first step in the operation is the same as for temporary dilatation described above (M. Desmarres' method). To introduce the canula the lips of the wound should be separated by pressing

upon their posterior edge with the handle of the bistoury. Then the canula should be inserted into the sac and duct ; and directly it has entered the duct the bistoury is to be withdrawn, and the canula pushed down until its upper edge disappears in the lachrymal sac. In order to ensure the proper position of the canula in the sac and duct the following experiment should be made. The nose and mouth of the patient being closed, he must be directed to make a strong expiration ; if the canula is in a proper position a little blood mixed with air will exude from the external wound. As a dressing for the wound we may apply to it a small piece of court plaster.

MM. Bérard and *Cloquet* dilate the duct with a tent before the introduction of the canula. This precaution is useful, as the walls of the duct are thus habituated to the contact of foreign bodies, and are less exposed to the inflammatory reactions which so often occur after the immediate introduction of canulas.

The form of the canula has been variously modified. That adopted by Pellier had two enlargements, one above and one in the middle. Dupuytren designed a canula with an enlargement of nitrate of silver, about the size of a millet seed, and closes up the wound with a piece of court plaster. An eschar is formed inside the sac and the duct, and is then discharged from above downwards. M. Lallemand has adopted this plan with success in several obstinate cases.

Haynes Walton slits up the lower canaliculus and reopens it with a probe as often as it reunites, till a canal is established, and then introduces a solid style, long enough to reach from the lachrymal sac to the end of the nasal duct. The style is allowed to remain till pus no longer escapes from the sac.

2. *The formation of an artificial duct.*

The operations we have described are often insufficient; and we must then make a new channel for the tears.

Wolhouse made a large opening into the lachrymal sac, by means of a semi-elliptical incision, and plunged a pointed stylet through the os unguis, having previously extirpated the sac. A tent of charpie or a small canula was then introduced to keep the perforation open.

Hunter made use of a punch to perforate the os unguis; but his operation requires special instruments, and is no longer performed.

Wathen made with a drill a new passage in the direction of the natural duct, and then fixed a permanent canula.

M. Laugier has proposed to perforate with a curved trocar the wall of the maxillary sinus, and to place a canula in the opening.

3. *Obliterations of the lachrymal passages.*

1. *Nannoni* destroyed the sac. To do this he made a large opening, filled it with charpie, and then cauterised it either with caustic or the actual cautery.

Bosche, relying upon the fact that the puncta lachrymalia may be congenitally obliterated without the patient suffering from watering of the eyes, cauterised the puncta by introducing into them a small piece of nitrate of silver.

2. *Removal of the lachrymal gland.—M. Paul Bernard* has successfully performed this operation in a case of chronic water-

ing of the eyes, which he attributed to a hypersecretion of the gland. The operation was as follows :—A vertical fold of skin is seized below the orbit, and on a level with the gland. An incision is then made from the base of the fold to its summit, with a fine bistoury; in such a manner that when it returns to its place a longitudinal wound is left of about a quarter of an inch in length, through which the orbit can be reached. It is then easy with a hook and scissors to detach and remove the gland.

Remarks.—The obliterations of the lachrymal passages, and the removal of the lachrymal gland, ought only to be resorted to after the measures described above have failed. We must therefore consider these two operations as offering the last chance of curing those cases which have proved rebellious to other modes of treatment.

PLATE XL.

OPERATIONS WHICH ARE PERFORMED ON THE MUSCLE OF THE EYE.

ANATOMY.

Fig. 1.—*Antro-posterior and vertical section of the orbit, showing the muscles of the right eye—external view.*—*a*, globe of the eye ; *b*, the levator palpebra superioris ; *c*, the superior rectus ; *d*, the external rectus ; *e*, the inferior rectus ; *f*, the inferior oblique ; *g*, the origins of the muscles of the eye.

Fig. 2.—*Represents the auponeurotic sheaths formed by the orbital aponeurosis.*—*a*, globe of the eye ; *b*, sheath of the elevator of the upper lid ; *c*, sheath of the superior rectus ; *d*, sheath of the external rectus; *e*, sheath of the inferior rectus ; *f*, sheath of the oblique.

Fig. 3.—*The disposition of the muscles and of their insertion into the sclerotic.*—*The eye is seen in front and the muscles are lifted up from behind forwards.*—*a*, superior rectus ; *b*, external rectus ; *d*, internal rectus ; *c*, inferior rectus ; *f*, the superior oblique muscle passing over its pulley, *e*.

Fig. 4.—*The operation for strabismus.*—*M. Sédillot's plan.*—The lids are kept away by a blepharectome, *a* ; *b*, a tenaculum entrusted to an assistant ; *c*, forceps raising a fold of conjunctiva ; *d*, scissors cutting the fold in order to expose the muscle.

Fig. 5.—A blunt hook, *a*, is passed beneath the muscle, b.

Fig. 6.—*a*, the blunt hook ; *b*, the scissors cutting through the internal rectus muscle.

The movements of the globe of the eye take place around three axes, an antero-posterior, a transverse, and a vertical axis. These movements are regulated by six muscles : the four recti and the two oblique.

The four recti have a fixed point of origin behind the globe around the optic foramen, from whence they diverge and embrace the globe from behind forwards into the anterior hemisphere of which they are inserted, about two or three lines behind the circumference of the cornea—an attachment that is very favourable for those rotatory movements of the globe which they determine. These four muscles are :—

1. The *superior rectus*, situated in the upper part of the orbit beneath the elevator of the upper lid. It raises the pupil by making the eye turn upon its transverse axis.

2. The *inferior rectus*, diametrically opposed to the preceding, also moves the globe upon its transverse axis, but lowers the pupil. It passes between the globe and the inferior oblique which is inserted above its external border.

3. The *internal rectus*, situated on the internal wall of the orbit, moves the eye on its vertical axis, and carries the pupil inwards.

4. The *external rectus* placed on the external wall of the orbit antagonises the preceding muscle. Its insertion into the sclerotic is a little nearer the cornea than that of the other rectus.

The two oblique muscles move the globe of the eye on its antero-posterior axis.

1. The *superior oblique* takes its origin from around the optic foramen ; from thence its direction is forwards and inwards as far as the internal orbital margin of the frontal bone, where it is

taneous action which is so indispensable to clearness of vision. This aponeurosis, after lining the orbit and forming the palpebral ligaments, is reflected upon the globe, envelops its two posterior thirds, furnishes sheaths to the muscles, and terminates behind in the neurilemma of the optic nerve. It contracts adhesions to the anterior portion of the muscles, just as these are about to be inserted into the sclerotic. This disposition does not always permit of each muscle acting separately. It accounts for the movements which persist after the muscle itself has been cut across, since the globe of the eye is thus subject to the movement of the orbital aponeurosis.

STRABISMUS.

OPERATIONS.

Strabismus is a fault in the regular convergence of the two visual axes.

There are four kinds of this affection: *Internal* or *convergent*, strabismus; *external* or *divergent; superior* or *ascending; inferior* or *descending.*

The indications and contra-indications for operating are to be drawn from the nature of the causes giving rise to the disease. We must only operate, when the strabismus is occasioned by muscular contraction, a circumstance which it is easy to determine by closing the sound eye, and making the affected eye deviate from its abnormal direction. This movement is impossible in cases of shortening or permanent contraction of the muscle; but still such inability to move the eye is not an absolute contra-indication, for it must be determined that the opposing muscle is not paralysed. Lastly, we should not think of operating when there are amaurosis, an artificial pupil, specks upon the cornea, a tumour in the eye or orbit, paralysis of the third or sixth pair of nerves, or symblepharon.

"When the affection is owing to paralysis of the sixth pair, the eye is turned inwards, and cannot be directed outwards. It is carried in an opposite direction in the case of paralysis of the third nerve; the upper lid has wholly or partially lost its motor power; and there is at the same time double vision.

"Old men and young children ought not to be operated upon:

in the former case, because as a rule the affected eye has become so weak that there is no hope of its acquiring afterwards sufficient power to perform its functions; and in the second case, because there often remain many chances of effecting a cure without an operation." (Desmarres, "Theoretical and Practical Treatise on Diseases of the Eyes."

Strumeyer's method.—The following is the simple and precise description which the author gave of his operation for spasmodic strabismus in 1829:—

"I close the sound eye and make the patient move the affected eye as far as possible out of its abnormal direction. If the strabismus is internal, I then thrust into the internal border of the ocular conjunctiva a fine tenaculum, which should be entrusted to an intelligent assistant, who takes care to keep the eye outwards. Having raised the conjunctiva with a pair of forceps, it is to be twisted with a cataract knife by an incision made in the direction of the internal angle, and the outward traction of the eye is increased until the internal rectus is brought into view; a fine probe is then passed beneath it, and the muscle divided the upper lid, to be held by the assistant behind; while the depression of the lower lid is secured by another assistant, who at the same time keeps hold of the patient's hands. The sound eye is to be kept shut. I will suppose it is the right eye which squints: it is upon that eye the operation is most simple (Internal Strabismus). The operator thrusts a small sharp tenaculum into the conjunctiva, near the caruncula lachrymalis, and draws the eye outwards; if the eye resists, a second tenaculum is to be implanted about two lines from the cornea, and the first one being confided to an assistant, the operator himself takes charge of the second. The conjunctiva being then raised into a fold by means of the two tenacula, the surgeon cuts into it with the curved scissors, and exposes the muscle. Then the scissors are abandoned; a hook is inserted between the muscle and the sclerotic; the tenaculum being no longer necessary to retain the eye in position, is disengaged, and the hand which was holding it seizes the hook beneath, while the muscle is cut through with the same scissors which are used for cutting the conjunctiva. By the section of the muscle the eye, freed from its shackles, immediately resumes its normal position. A little ablution with cold water is then all that is required.

"To operate upon the left eye the surgeon passes his left arm in front of the patient's forehead, and with his hand curved from without inwards holds the tenaculum which is inserted in the sclerotic; the assistant, standing behind the patient, holds the elevator with his left, and the tenaculum with the other hand."

When the strabismus is slight, Dieffenbach has proposed to raise with the curved scissors a small flap of the conjunctiva, and of the contracted muscle. Cullier recommends us to combine (joindre) the suture with the excision, and to divide the muscle he makes use of the boutonnés eye-scissors.

M. Phillips excises the tendinous portion of the muscle.

M. Bonnet raises the conjunctiva with forceps, and having divided it, cuts the muscle with a small scalpel inserted between the muscle and the sclerotic.

M. Velpeau seizes with a pair of claw forceps a large fold of conjunctiva along with the insertion of the muscle into the sclerotic. The surgeon can himself hold the forceps when the operation is performed upon the right eye, but must give them to an assistant in the case of the left eye. A second pair of forceps seizes and raises a fold a little distance from the first. This second pair of forceps is entrusted to an assistant. The bridle between the two instruments is then excised with either the straight or curved scissors. The operation may be finished with one snip of the scissors.

M. Lucien Boyer, having observed that after the perpendicular division of the conjunctiva the caruncula lachrymalis becomes sunken and retracted, proposes to make the incision into the conjunctiva a horizontal one, and above the tranverse diameter of the cornea.

M. Sédillot's method.—M. Sédillot thus describes this method : "We seize the conjunctiva with a simple hook, to turn the eye outwards, in the case of convergent strabismus. A tenaculum is then inserted into the sclerotic, a little internal to the cornea, which is taken charge of by an assistant, while the surgeon withdraws the first. Raising with an ordinary pair of forceps a fold of conjunctiva a little inside the tenaculum, we divide that membrane with one cut of the scissors, and by cutting in succession

PLATE XLI.

OPERATION FOR CATARACT BY DEPRESSION.

Fig. 1.—*Antero-posterior section of the eyeball.*—*b*, cornea; *c*, anterior chamber; *d*, iris; *e*, crystalline lens; *f*, capsule of lens; *g*, vitreous humour.

Fig. 2.—*Depression of cataract.*—*First stage* (*right eye*).—*a*, *a*, assistant's fingers raising the upper lid; *b*, *b*, operator's fingers pulling lower lid down; *c*, instrument held in left hand and passed through the sclerotic. The operator's third and fourth fingers are steadied by resting on the cheekbone.

Fig. 3—*Same operation.*—*Second stage.*—The needle, *a*, is passed between the lens and the iris; the concavity of its point is occupied by the upper edge of the lens.

Fig. 4.—*Same operation.*—*Third stage.*—*Depression.*—The handle of the needle, *a*, *b*, being raised, the point is lowered, and presses the lens down into the vitreous humour.

Fig. 5.—*Same operation on the left eye.*—*a*, position of the needle in the first stage; *b*, in the second stage; *c*, in the third stage.

Fig. 6.—*Reclination.*—The lens, *a*, is displaced, *b*, into the vitreous humour.

PLATE XLII.

CATARACT AND ARTIFICIAL PUPIL.

Fig. 1.—*Extraction of the cataract.—First stage.—Inferior keratotomy.—a, a*, assistant's fingers raising the upper lid; *b, c*, middle and index fingers of operator depressing the lower lid; *d*, right hand of operator holding the cataract knife. The figure represents the instrument when it passes out of the cornea.

Fig. 2.—*Same operation.*—The inferior flap completed.

Fig. 3.—*Same operation.—Second stage.*—Opening of capsule by cystotome, *a*.

Fig. 4.—*Same operation.—Third stage.*—Expulsion of cataract. The handle of an instrument presses lightly on the upper lid, while the operator pushes the lower lid gently upwards with his finger, *a*.

Fig. 5.—*Finger armed with Desmarres' ring.—a*, the ring; *b*, little claws which are fixed into the sclerotic.

of the instrument being brought out below forms a flap of iris and cornea.

Fig. 13.—*Detachment of iris—Scarpa's operation.*—A needle, *a*, introduced through the sclerotic, detaches the iris from above downwards.

OPERATIONS ON THE EYEBALL.

ANATOMY.

We shall confine ourselves to mentioning and shortly describing the parts forming the eyeball, which are of importance as concerning the operations performed on that organ. Passing from the circumference of the organ towards its centre, we find first—

The conjunctiva, a thin vascular membrane; which, having lined the inner surface of the lids, passes over the eyeball to invest all the visible parts of the cornea and sclerotic. At the inner angle of the eye it forms a rather deep cul de sac before passing on to the sclerotic.

The transparent *cornea* is intimately connected with the sclerotic. It is formed of successive layers, between which an instrument may easily slip, if not introduced with decision. It is hard and firm; incisions in it need to be made with very sharp instruments.

The sclerotic stretches from the nerve to the cornea. It is white and tough, resisting and elastic, and must be penetrated by a sudden and confident movement, the point of the instrument being perpendicular to the surface. The muscles of the eyeball are inserted into it.

The choroid lines the inner surface of the sclerotic, and is slightly adherent to it. The membrane is composed of two distinct parts, the inner one formed entirely of pigment, the outer essentially vascular. Between the sclerotic and choroid the ciliary vessels and nerves pass.

The long ciliary arteries are internal and external, passing forwards between the choroid and sclerotic in the plane of the transverse diameter. Hence, to avoid wounding them, it is best to pierce the sclerotic above or below the transverse diameter of the eye.

Between the sclerotic, choroid, and iris, at the level of the margin of the cornea, is the greyish ring of the ciliary body. It is essentially vascular, containing also a network of nervous, besides muscular fibres. Instruments passed into the eyeball should keep clear of this structure. *The ciliary processes,* folds formed by the inner layer of the choroid, are found behind the iris; they surround the lens, and are in contact with its equator.

The iris, the diaphragm placed between the cornea and the lens, divides the front part of the eye into two chambers—the anterior between itself and the cornea; the posterior between itself and the lens. The lens and the iris are in contact, hence the passage of an instrument between the iris and lens is dangerous to both.

These two chambers communicate by the pupil, a circular opening placed in the centre of the iris. The outer margin of the iris is connected with the ciliary circle. The iris floats freely in the eye, directly the pressure of the fluids keeping it in place is disturbed. Care is necessary to avoid wounding the membrane, as, for instance, when penetrating the anterior ciliary processes, serves to keep the lens in place. The operation when performed in cases of "general cataract," viz., declination of the lens and capsule together, is rendered very difficult by these adhesions. In cases of milky or lenticular cataract, it is only necessary to lacerate the capsule, to allow the escape of its contents.

Behind the lens is the *vitreous body*, the gelatinous mass which fills the posterior four-fifths of the eyeball. An exceedingly thin membrane (the hyaloid membrane) envelopes the vitreous body, and by its numerous processes encysts the substance, in cells of various sizes and shapes. In the operation of declination it is often necessary to rupture some of these partitions with the needle.

CATARACT.

Cataract is total or partial opacity of the crystalline structures. Their physical characters serve to show that there are many kinds of cataract. We will only mention such of these characters as help us in the choice of operative methods.

As regards its locality, opacity may affect—1. The enclosing membrane, as in *capsular cataract*. 2. *Morgagni's humour*, as in "milky cataract." 3. The *lens*, as in lenticular cataract. 4. *The lens* and *capsule*, as in capsulo-lenticular cataract.

Cataracts may be hard, soft, or liquid. Lenticular cataracts are usually hard and dull; they are often seen in old people, and extraction is the only treatment.

Capsular cataracts are soft, and clearer than the last. Milky cataracts are fluid, with less opacity in the upper segment than in the lower segment, the opaque particles sinking by their weight. Soft, fluid cataracts are easily re-absorbed, and therefore are those to which the operations of reclination and of solution are applicable. Young subjects are specially liable to this form; in time the opacity affects the lens, so that it is advisable to treat congenital cataracts in infancy.

The depth of the cataract is shown by the amount of shadow cast on the lens by the iris. In capsular cataract the shadow is least developed, and when quite absent, it is presumable that there are adhesions, or contact of the iris with the hypertrophied or displaced lens and capsule.

Indications for operation.—The general conditions of success are the following :—Satisfactory general state of health; soundness of the eye; absence of the slightest degree of inflammation in any one of the tissues; clearness of cornea; mobility of pupil; non-adhesion of iris; sensitiveness of retina; maturity of the cataract, as established by complete loss of sight; patiently to wait till both eyes are affected by cataract, so as not to compromise the sound eye by unforeseen and often grave accidents which may follow the operation on the diseased eye; early operations on infants; favourable climate.

Excessive heat or bitter cold are alike injurious.

METHODS OF OPERATING.

Cataract operations are designed to remove from the pupil any opaque body which prevents the rays of light from reaching the retina. The numerous procedures devised to accomplish this result can be classified under three heads: 1. *Reclination or Depression*—the opacity is only displaced;

first and middle fingers. This elevation requires great delicacy, as no compression must be exerted on the globe of the eye ; and yet it is most important that the lid should not slip and encumber the surgeon's instruments during the operation. Thus it will be well, according to M. Desmarres, to chalk the tips of the fingers that the lid may not slip. The means for steadying the lids indicated for strabismus may also be made use of.

If the surgeon is ambidextrous, he can operate on either eye without change of position; but in the opposite case it will be necessary for him to stand behind the patient if he is operating on the right eye.

For fixing the eye, a little double hook may be inserted into the sclerotic; but most commonly the operator obtains the necessary immobility by means of the first two fingers of the disengaged hand; the first finger depressing the lower lid, while the ring finger, placed higher and farther inwards near the lachrymal caruncle, exerts gentle pressure outwards on the globe. On this finger Desmarres wears a ring, to which are attached two little points, or claws, which he fixes in the sclerotic (Plate XL., fig. 5).

§ 1. *Depression.*—This is performed with cataract needles. Scarpa's needle is more bent than Dupuytren's, and has a projecting ridge on the concavity, which enables the operator to give more force to the point of the instrument, but is inconvenient as being more likely to break up the lens when the needle is pressing on the cataract to depress it.

Dupuytren's needle, flatter and smaller at the point, has a conical stem, which fills up exactly the wound by which it is passed in; this renders the vitreous less likely to escape. The handle of these needles is marked with a little black spot, showing the convexity of the point, and serving as a datum while moving the instrument within the eye.

Depression may be performed by penetrating the sclerotic, called *scleroticonyxis*, or the cornea, *keratonyxis*. There are varieties of these principal operations.

a.—Scleroticonyxis (*left eye*).

First stage.—Puncture.—Left eye.—The operator lowers the under lid and fixes the eye with the first two fingers of the to the direction of the ciliary vessels. The patie look inwards. The needle is immediately passed sclerotic, $\frac{1}{12}$ to $\frac{1}{10}$ inch behind the transparent corne to $\frac{1}{12}$ inch below its equator. A puncture closer to t risks wounding the iris and ciliary body; if farther cornea, there is danger of piercing the lens, and thr the withdrawal of the needle behind the iris more Lastly, in puncturing below the equator, we avoid t artery which runs at this level between the ch sclerotic. The puncture should be made by one move boldly, for at this moment patients often start bacl place the needle.

Second stage.—Passage of the needle between the iri —The needle passed through the sclerotic is withd carefully, until only the curved part is left inside Then the first movement of rotation imparted by the the handle of the instrument turns the concavity of backwards, and brings the convexity forwards; the acts as guide in this manœuvre. At the same time, movement, combined with the first, the handle of the is slightly raised and drawn towards the temple, s point passing round the lower edge of the lens, witho it, can be placed between the lens and iris. Conta sion between these structures render this manœu great delicacy. The needle, now in a horizontal the operation. The division of the capsule is effected with the edge of the needle, which is made to pass with a to and fro movement, first upon the lower and then the upper capsule.

Fourth stage.—Displacement of the cataract.—The capsule being divided, the concavity of the needle is applied to the upper margin of the lens, and by a careful see-sawing movement, in which the handle is raised and carried forwards, the lens is pushed downwards and outwards into the vitreous. The needle is held in this position for eight or ten seconds. The displacement must be effected gently, that the lens may not rise over the needle, which might lodge it in the anterior chamber. If that accident should happen, the lens must be speared with the needle and carried back through the pupil; and if that attempt should fail, the cornea must be cut through, to allow the lens to escape.

To obviate this difficulty M. Gerdy has devised a needle whose point is made to bifurcate after it has been introduced —the two branches, embracing the lens, enable the operator to gain a better hold and to conduct it safely to the lower part of the eye.

b.—Reclination is only a modification of the last stage of the above. The needle pushes the lens down and backwards in the vitreous, and then lays it flat, so that the anterior surface is upwards (Plate XLI., fig. 6). This kind of depression is applicable to soft cataracts, when the capsule and lens are displaced together. After the displacement it often happens that the flaps of the capsule, or the fragments of the lens, separated by the pressure of the needle, float in the centre of the eye.

These must be separately attacked and dispersed in the humours to favour their absorption. This will prevent the formation of secondary cataracts, which often result from the reunion of the flaps.

c.—Laceration is especially applicable to soft liquid cataracts. In this operation the capsule is torn, and its fluid contents escape into the humours of the eye, there being absorbed. If the cataract, though soft, is capable of being separated into pieces, these, by reduction in size, will be more easily affected by the humours.

In the case of cataracts which adhere to the iris, it will be necessary to limit the laceration to the field of the pupil. This operation is performed with a little hook slipped flat between the capsule and iris; when opposite the pupil the hook is turned towards the capsule and divides it by radiating lines.

d.—Suction is only applicable to fluid cataracts. Laugier passes into the lens a hollow needle, which has an aspirating opening near its point. The needle is mounted on a little exhausting syringe, which extracts the cataractous fluid.

Blanchet uses a hollow needle, which is furnished with an elastic india-rubber ball instead of a syringe, to exert suction.

Petit, Ferrein, and Bowen have attacked the lens from behind, dividing the capsule; the lens alone was depressed, the anterior layer of capsule being left in place.

Bretonneau and Velpeau, having passed the needle through the sclerotic, freely divide the hyaloid cellules before passing the instrument over the edge of the lens, thus preparing the way by which the lens is to descend into the vitreous.

Bergeron and Goirand detach the lens all round from the vitreous, then, having separated it from the ciliary processes, through the cornea, is only now employed in those rare cases where the eyes, deep in the sockets and very mobile, cannot be easily steadied. All the movements of the needle take place in the pupil, the edges of which are constantly fretted, while the loss of the aqueous, the passage of the lens into the anterior chamber, cicatrices in the cornea, etc., are serious accidents, and the operation being difficult, they have long since led to the abandonment of keratonyxis in most cases.

First stage.—Puncture will probably lead to an opaque cicatrix, so that it should always be made towards the periphery, and preferably in the lower segment. If there were already an opaque spot, that should be chosen for the needle wound. The instrument is to be introduced with the edges upward and downward, so as to make a little vertical incision.

Second stage.—Depression or laceration.—The point of the needle being well in the anterior chamber, a rotatory movement brings its concavity towards the lens. The capsule is to be divided as usual, then the flat of the needle being carried above the lens, it is to be pushed down into the vitreous by a lever movement, raising the handle of the instrument and passing it inwards.

In laceration, the lens is pierced, and division of its substance is attempted by rotating the needle rapidly. Central laceration by keratonyxis is alone practicable when cataracts adhere to the iris.

2. *Extraction.*

The expulsion of a cataract may be effected through a corneal wound (*keratotomy*), or a sclerotic wound (*sclerotomy*). A cataract knife, or keratotome, to cut through the cornea; a needle or a cystotome to divide the capsule; a little scoop, ocular forceps, and fine scissors, complete the apparatus. Wenzel's knife is lancet-shaped, and is convenient for incising the cornea and the capsule at the same time, but it is inconvenient, as not filling up the wound made in the cornea, which favours the escape of the aqueous. Richter's knife, more commonly used, has a short triangular blade, which exactly fills up the corneal wound. The shortness of the blade lessens the risk of woundng the inner angle of the eye.

The rules for attention to the general health given in treating of depression are equally applicable to keratotomy.

The incision in the cornea forms a flap which may be inferior, oblique, or superior—the three varieties are called inferior, oblique, or superior keratotomy.

Inferior keratotomy (Plate XLII., figs. 1, 2, 3, 4). *First stage—Incision of cornea* (fig. 1).—The point of the instrument is brought against the cornea at the level of its equator at $\frac{1}{20}$ to $\frac{1}{12}$ inch in front of the sclerotic; a sharp and decided puncture is made into the anterior chamber, then a pause is made to ascertain that the iris is not wounded, after which the handle is carried backwards a little and the point is pushed from without inwards, in the equator of the globe, until a counter-opening of exit is made exactly opposite the point of entrance; the blade of the instrument is to be kept parallel to the plane of the iris all the while. When the point has passed from one side to the other of the cornea, the knife is to be handled most gently, without any sudden movement, that the flap may be cut with its edges exactly parallel to the border of the sclerotic. Too much this does not happen, it is enough to press the finger or handle of a knife on the upper lid, when the lens will pass through the pupil into the anterior chamber and slip out through the corneal wound. The escape of the lens can be further assisted by double pressure: one finger on the upper and one on the lower lid. There are sometimes fragments of the lens or capsule remaining in the pupillary field: these must be removed with fine forceps or a curette, lest secondary cataracts should be formed.

Oblique keratotomy.— Wenzel's operation (fig. 6).—The point of the knife is to enter the cornea at the middle point of the outer and upper fourth, and to make exit at the centre of the inner and lower fourth. This form of operation is more difficult than the last; but the cicatrisation of the wound is more rapid, the lower lid is less likely to catch under the flap, and there is less risk of wounding the nose and internal caruncle when making the corneal wound.

Superior keratotomy.—Richter, Wenzel, and Jaeger's operations (fig. 7).—This is performed just like the oblique and inferior operations. The base of the flap corresponds with the equator of the cornea, and its free edge is upwards. The difficulty of this procedure is greater than that of the two preceding operations; but it has the advantage of less frequently allowing the aqueous to escape. Cicatrisation is rapid, the flap being supported by the upper lid.

Furnari's operation.—Furnari uses a double-edged knife, ending in a point slightly curved on the flat, which is employed for opening the capsule. The anterior chamber is opened at one side by the knife, with which the capsule is then incised; then by the corneal wound a pair of fine forceps is passed in, the lens seized and removed (Plate XLII. figs. 8, 9).

Sclerotomy.—Proposed by Bell, but abandoned. An incision was made in the sclerotic, through which forceps were introduced and the lens removed. But this proceeding endangers wounding the ciliary arteries, evacuating the vitreous, and causing choroiditis, retenitis, etc.

3. *The mixed operation* (*Quadri*).

It consists in passing a needle through the sclerotic, with which the lens is broken up; fine forceps are then introduced through a corneal wound, the capsule is divided, and the pieces of lens removed. This operation is almost abandoned.

OPERATIONS FOR ARTIFICIAL PUPIL.

Cheselden first made an artificial pupil in 1728, since which the operation has undergone many modifications. The fact is accounted for by the number of different conditions calling for this treatment. The surgeon will be guided in his choice of operation by the affection he has to treat.

The various operations may be placed in four classes:—1. Incision of iris, or *iridotomy;* 2. Excision, or *iridectomy;* 3. Separation from its border, or *coredialysis;* 4. Displacement of the pupil, or *corectopy.*

For preliminary treatment, and position of the patient, surgeon, and assistants, see the chapter on Cataract Operations.

that the incisions made by Janin's method have the same tendency to close as those of other surgeons.

Compound iridotomy.—Whatever the method used, simple incision of the iris is almost always followed by union of the edges of the wound. To remedy this fault, surgeons employ a mixed operation. *Guerin's method.*—To combine the advantages of the two preceding operations, Guerin opened the cornea as the first step, and made a crucial incision (perpendicular and horizontal) in the iris. *Flajani* operated in the same way. *Maunoir* also cut through the cornea at the outset; then with bent, fine scissors he cut a triangular flap in the iris, having its point at the centre, and its base at the circumference. *Carron du Villars* used Maunoir's operation, but not his scissors, preferring scissors with a spring to keep them open. This is a great help. *Velpeau* (Plate XLII., fig. 12) uses a narrow knife, double-edged, and resembling the "*serpent's tongue*" lancet. The knife is introduced through and across the cornea ; the point pierces the iris backwards, entering the posterior chamber, then, after its horizontal course has continued for three or four millimetres, the point is brought again through the iris (this time forwards). The knife, being brought out, cuts a flap of iris, which rolls itself up and soon disappears, leaving a triangular pupil.

Remarks.—Iridotomy is generally easily and rapidly performed; there is less fear of inflammatory accidents than in other methods; but it is unreliable, the reunion of the edges of the wound rendering the operation useless. The same remark holds good with the mixed operation in some instances.

Excision of the iris (*iridectomy*).

Wenzel's operation (Plate XLII., fig. 12) only differs from Velpeau's operation (described above) in that Wenzel cuts off and removes the little triangular flap which Velpeau cuts and leaves in the eye. *Sabatier* made a corneal flap as in cataract, drew the iris out through the wound, and cut off a portion with scissors curved on the flat. *Mulder* first made a crucial incision in the iris (Plate XLII., fig. 10), and then with scissors cut off each of the triangular flaps. *Physick* used forceps with a punching blade. One of the blades is passed behind the iris, the other in front; when closed the forceps will cut out a circular piece of iris. *Leroy d'Etoiles* operates on the iris *in situ*, using a little instrument whose mechanism resembles that of the tonsillotôme. A little turning hook seizes the iris and draws it between two rings, which, sliding one on the other, cut off the seized portion of iris. *Beer* makes a small incision in the cornea, through which he passes a small hook; with this he seizes the iris and brings it out through the wound, and cuts off a suitable portion with the scissors. This latter mode of operation has been modified by *Gibson* and others. *Desmarres* pierces the cornea with eye forceps, draws out a portion of iris, and cuts it off.

Remarks.—Iridectomy has the simple advantage over incision that reclosure of the pupil is not likely to follow; but it is more difficult, requiring much endurance on the part of the patient, and much confidence and steadiness of hand on the surgeon's part.

Tearing of the iris (coredialysis).

Langenbeck's operation adds enclosure in the corneal wound to separation. An opening $\frac{1}{12}$ to $\frac{1}{8}$ inch in length is made in the cornea with an ordinary keratotome, through which is passed a small hook enclosed in a movable sheath; the hook is disengaged, made to seize the iris and draw the separated flap into the corneal wound, where it forms adhesions which prevent the newly-made pupil from closing. *Jungken*, *Græfe*, and *Reisenger* have altered the instrument, but retain the operation.

Luzardi devised an instrument consisting of two sliding bars, kept together by a spring. The needle is easily passed into the eye, through the cornea or sclerotic, no incision having been previously made; when it has reached the iris, one of the bars of the instrument is drawn back, which exposes the hooked extremity of the other bar, and the iris is seized with this latter; a spring sends back the sliding bar, which secures the iris on its hook and enables it to be drawn into the wound.

Donegana adds incision to separation. A little falciform needle, the concavity sharp, is introduced through the cornea or sclerotic; the iris is separated with the blunt convex margin, and cut through to the centre with the concave edge.

Huquier, having noticed that the iris when detached is hard to incise properly, yielding before the instrument, begins by cutting from the centre outwards, and then separates each of the lips of the wound.

Remarks.—All operations by scleroticonyxis expose the lens to danger; further the needle hidden by the iris is guided with difficulty, and may be misdirected. In operating by keratonyxis these dangers are avoided, and all points of the circumference of the iris are easily approached.

Separation alone is not always successful for any length of time: the separated iris may unfold and obliterate the new pupil. It is therefore best to enclose the separated iris in the external wound. Langenbeck and Luzardi's operation are suitable to the great majority of cases. The process of detachment is especially adapted to all cases where the iris adheres to the capsule, where there is anterior synechia, or where there is extensive corneal opacity.

Displacement of the natural pupil (corectopy).

This operation is applicable to cases in which the pupil is veiled by a central nebula of the cornea. The end in view is placing the pupil behind a clear part of the cornea.

Adams made a little incision in the cornea, into which he drew the edge of the iris, in order to displace the pupil. When healing, the corneal wound formed adhesions which kept the pupil in its new position. *Himly* performed a similar operation.

Guepin and Desmarres have devised a kind of punch which takes a small piece out of the cornea, into which the iris prolapses if it does not take the required position of itself; a little pressure on the eye will cause it to do so. As the corneal wound heals, the iris is maintained in its new position.

Remarks.—Corectopy is easily performed, and is less liable to cause inflammations than the other methods. But it is not applicable to cases in which the pupil or iris has undergone any morbid change.

opaque spot, or even around the whole cornea, obliquely through half the thickness of the cornea. The little circular flap thus formed was then dissected off.

The Seton.—Pellier, and Delarne have published some observations made by them on the results of passing a thread between the layers of the cornea, by means of a fine flat needle. It was exceedingly difficult to accomplish, and full of danger; and though successful in some cases, has been abandoned, as have also trephining, and resection of the opacity.

Abrasion of the cornea.—This operation, which replaces an opacity by an ulcer, is condemned by most surgeons. Malgaigne employed it successfully in the case of his daughter. Yet it should only be tried when the sight is quite lost, and then not until all other means have failed.

The lids being separated, and the eye fixed either with forceps or hooks fixed into the sclerotic, the operator holds the cornea with mouse-toothed forceps, and raises the superficial layer with a cataract knife. In this tedious and painful operation the anterior chamber is often wounded. It should be reserved for the metallic stains produced by the excessive use of badly prepared collyria containing lead or silver.

PTERYGIUM AND PANNUS.

The former is a kind of excrescence appearing on the cornea, almost always of a triangular form, seated in the inner angle of the eye. The latter, of no regular form, may appear in any part of the cornea; the same operative measures are applicable to both forms of disease.

The little outgrowth is seized with a double hook, or with rat-toothed forceps, and is cut off with a fine scalpel, or with scissors curved on the flat; nitrate of silver is then applied to the wound. These affections often recur, and are apt to leave an opaque spot on the cornea after their removal.

HYPOPYON.

Accumulations of pus in the anterior chamber are soon reabsorbed in most cases, so that an operation is rarely called for. If it should be necessary, puncture of the cornea is performed with a simple cataract knife at the lowest point.

ACUTE PHLEGMON.

In cases of this disease, the pain caused by purulent accumulation becomes intolerable, and an outlet must be made for the fluid. *Scarpa* cut the cornea at its centre, and raised a circular flap—a tedious process. It is better to open the cornea at its lowest point, by a straight incision with a cataract knife. There is then a chance of preserving the transparency of some part of the cornea.

HYDROPHTHALMIA

may distend the ocular globe to such a degree, or be attended by such intense inflammation, that it calls for puncture. The liquid may be partly or wholly let out, by making an incision through the cornea or sclerotic. Desmarres, for puncturing the sclerotic, makes use of an instrument like a short lancet, having near the point two shoulders, which prevent the blade from entering too deeply. The blade has

If the lids are to be removed with the ball, the first incisions must be carried through them and not through their mucous lining.

When no tumour is connected with the eye the incision in the lids is unnecessary. The conjunctiva should be carefully dissected up from the globe in order to cover the stump; then, seizing the eye with the hook, or forceps, cut through the muscles, either with the curved scissors or with the bistoury, finally severing the optic nerve.

FITTING AN ARTIFICIAL EYE.

The stump left after an extirpation having completely healed, a well-fitting enamel eye is obtained. The upper lid is raised while the most convex part of the enamel eye is passed underneath it; then the lower lid is drawn down till the lower edge of the eye slips over it. It should not be left in place for a long time at first; the stump becomes in time accustomed to its presence. If the orbit holds it too loosely, it must be replaced by a larger one.

The enamel eye is removed by means of a blunt gold or silver probe bent into a hook; the instrument is passed between the eye and the lid (drawn down at the time); a gentle lever movement raises the eye and makes it glide out of the orbit.

PLATE XLIII.

OPERATIONS ON THE EAR.

Fig. 1.—*Section showing the (angular) relative direction of the Eustachian tube and external auditory passage.*—*a*, inferior turbinated bone; *b*, middle turbinated bone; *c*, opening of the Eustachian tube at the level of the attachment of the lower bone; *d*, first angle in the Eustachian tube which from this point turns more directly outwards; *e*, membrana tympani; *f*, external auditory canal, which, passing from within outwards, completes in the horizontal plane the arc of the course of the Eustachian tube; *g*, internal carotid.

Fig. 2.—*Perforation of the lobule of the ear.*—*a*, trocar; *b*, cork applied behind the lobule to make counter-pressure.

Fig. 2, *bis.*—*Trocar for this operation, and for introducing the rings.*

Fig. 3.—*Extirpation of a polypus of the external ear.*

Fig. 4.—*Perforation of the membrana tympani.*—*a*, *b*, De-ear have been attended with much loss of substance (see Blepharoplasty). In all cases the repairing flap of skin will be so arranged that its dermal surface is outwards.

Foreign bodies in the auditory canal.—It would be hard to name all the foreign substances which may be found obstructing this canal, but they come under two classes:—1. Those which form in the ear, hard or soft wax, pus, blood clots, etc.; 2. Bodies from without.

Extraction of foreign bodies may be effected by curettes, or forceps, whose curves and whose sizes are suitable to the direction of the auditory canal. The surgeon will choose his mode of proceeding according to the form, hardness, or softness, etc., of the foreign substance. By drawing the external ear (with the left hand) upwards and outwards the curves of the canal are somewhat straightened, and the entrance of instruments rendered easier. The canal should also be well oiled, and the introduction of a speculum will help to dilate the soft parts and facilitate the use of instruments for breaking up the impacted body more easily. It is well to remember that in the adult the vertical diameter of the canal is greater than the transverse. We must, therefore, pass instruments along the floor to insinuate them more easily under the foreign body. In children, on the other hand, the horizontal diameter is greater than the vertical. In the second place, the tympanic membrane slopes downwards and inwards, which must be remembered, that the drum may not be wounded, and that the foreign body be not pushed back into the angle which the membrane makes with the anterior wall of the passage.

Thickened wax and similar substances can be softened and expelled by injections of lukewarm water. Solid bodies are often removable by this means, the reflux of the injected water carrying them out. If all these methods fail, it would be well to try the plan of Paul d'Egine, who made a small incision behind the concha of the ear, through which he passed a stylet, which was to pass inside the foreign body and expel it.

Polypus of the auditory meatus.

Polypi may be removed or destroyed by ligature, excision, torsion, and cauterisation. The nature, colour, and size of the polyp will indicate to the surgeon which proceeding to adopt.

Ligature can be done directly or by means of Desaute's ecraseur, a slip-knot being passed over a pedunculated polypus.

Torsion is suitable to most cases; steel forceps are used. The hæmorrhage, which is often free, is easily arrested by cauterising. Nitrate of silver, or Vienna paste, is the means usually employed; great care is needed, and it is better to pass a little plug of cotton wool to the bottom of the canal to protect the tympanic membrane from the caustic.

Absence and obstruction of the auditory meatus.

Congenital absence of the canal resulting from contact of the bony walls is beyond the surgeon's powers to relieve. But when a membrane (of variable density), situated more or less deeply in the canal, obliterates it, the obstacle may be removed by puncture, incision, or cauterization. It will always be prudent to begin with an exploratory puncture, to prove the presence of a canal behind the membrane; if then the [redacted] when deafness is caused by permanent stoppage of the Eustachian tube. It may be performed by puncture, excision, or cauterization.

1. *Puncture—A. Cooper's operation.*—A small curved trocar is passed along the floor of the external meatus, up to the tympanum. When the point has reached the membrane it is pushed sharply through it, about $\frac{1}{16}$ of an inch, and the patient recovers his hearing at once.

Buchanan's operation only differs from the preceding in the form of the trocar, which is square. When the membrane is punctured, the opening is enlarged by rotating the trocar.

2. *Excision.—Himly's operation.*—Puncture as performed in the above ways is liable to close up again. To avoid this failure, Himly punctured the membrane and excised a portion by means of a punch, which has since been improved by Falrizi and Deleau. Deleau's perforator consists of a canula, whose extremity has a circular cutting edge; the canula encloses a point whose base has also a cutting edge. A spring when turned causes the point to protrude, and perforate the membrane; directly afterwards another spring causes its return, a circular piece is cut out of the membrane by the contact of the cutting base of the point, and the cutting edge of the canula (Plate XLIII., fig. 4, shews the application of this instrument).

3. *Cauterization*, as proposed by Richeraud, is now almost abandoned.

Perforation of the mastoid cells.

The communication which exists between the mastoid cells and the tympanic cavity has suggested to surgeons the idea of opening a passage to the external air by perforating the mastoid process. The operation can be done with a little trephine, a trocar, or a perforator. The most favourable spot is a little in front of the process, $\frac{3}{8}$ to $\frac{4}{8}$ of an inch above its point (Malgaigne).

Perforation of the mastoid cells is not only indicated in certain forms of deafness, but is sometimes of use to afford an outlet to pus and other fluids contained in the cells or the middle ear, resulting from abscess or organic lesions of the process.

This operation does not always afford good results; it is not absolutely free from danger, and is sometimes fatal.

These considerations, and the fact that the cells are sometimes atrophied (when puncture is useless), make surgeons cautious in using it.

Catheterism of the Eustachian tube (Plate XXXVIII., fig. 1).

This duct is about one inch and a half long, with an opening (shown at *c*, Plate XLIII., fig. 1) looking downwards, inwards, and forwards; the aperture being behind the inferior turbinated bone, *a*. The orifice can therefore be reached either through the mouth or through the nasal fossa. Fig. 1 in Plate XXXVIII. shows Deleau's probe, *a*, lying on the floor of the nasal fossa, its point within the Eustachian tube at *e*. The object of this procedure is to clear the tube, which result is obtained by injecting air or medicated fluids.

Guyot, postmaster at Versailles, in 1724, was the first person of the nostril. Gentle to and fro movements of the sound or catheter are then to be made until the point is caught in the orifice of the Eustachian tube. Success is shown both by the fixedness of the instrument and the peculiar sensation which it gives in the ear of the patient. To inject the passage, the catheter is kept steady by pinching the nostril through which it has been passed, and the jet of a syringe is placed in the external opening of the catheter.

Deleau's method (Plate XXXVIII., fig. 1).—Instead of a silver probe, Mr. Deleau uses a flexible tube, which can be passed deeper into the Eustachian duct without cutting in its windings. A stilette inside this tube gives it steadiness and imparts a convenient curve. The end of this stilette is made to project from the catheter, and passes easily into the nasal opening of the duct; it serves then as a guide along which to pass the catheter as far as possible, and the former is then withdrawn. The outer end of the catheter is somewhat expanded, and is fitted with a bent wire, acting as a spring, and retaining the instrument in the nose by pinching the nostril.

While thus fixed it is easy to use the apparatus for injections. Air is chiefly injected by Deleau, by means of a caoutchouc ball syringe, squeezing which causes a current of air in the duct.

These air douches afford in certain cases valuable means of diagnosis. The operator applies his ear to the ear of the patient, and easily detects the fact when the air enters the tympanic cavity and returns between the tube and the Eustachian tube. In this case the obstruction is incomplete. If the air current passes through the middle ear and out at the external ear, there is a perforation of the tympanum. And rattling or gurgling sounds heard in the above described manner indicate the presence of pus or other fluids in the middle ear.

When the nostril of the same side as the obstructed tube is itself affected, catheterism may be practised through the *other* nostril, taking care that the instrument has a longer curve, and that the length of the bent part is proportioned to the greater distance to be traversed, to reach the opening of the canal. To assist the introduction of the catheter it will be well to turn the tip backwards a little, on the convex side of the curve.

Gairal passes the sound along the nasal fossa till the point no longer rests on the floor, then makes it turn a quarter of a circle upwards and outwards: after this, it is only necessary to push the sound a little further to make the point enter the opening of the Eustachian tube, at the same time gently rotating outwards to pass the catheter further into the duct.

The mouthpiece of Gairal's sound is graduated to show the degree of rotation practised.

OPERATIONS ON THE LIPS.

A fold of *mucous membrane under the upper lip* is seen in some persons while laughing, like a cushion stretching across, and, as it pushes forwards, lifting the lip and everting it. To cure this deformity, it is enough to seize the fold with forceps, and cut it off with scissors curved on the flat. Compresses, soaked in cold water or alum lotion, tucked in between the lip and the alveolar process of the jaw, usually suffice to

PLATE XLIV.

HARELIP, CHEILOPLASTY.—CONTRACTION OF THE BUCCAL ORIFICE.

Fig. 1.—*Simple harelip.*

Fig. 2.—*The same after operation.*—Three points of twisted suture unite the edges of the wound.

Fig. 3.—*Double harelip.*

Fig. 4.—*The same after operation.*

Fig. 5.—*Cheiloplasty.*—The cancerous mass, *a. c, d, a*, is contained between two incisions, *a, c, e*, and *a, d, e*. The commissures are extended by two incisions, *a, b*, and *a. b ;* the two edges, *a, d, e* and *a, c, e*, will be opposed and united in the median line by points of suture.

Fig. 6.—*Chopart's method.*—Two incisions, *a, e* and *d, f*, bound a quadrilateral flap, *a, e, f, d*, from which the diseased structure is cut away by the incision, *b, c.* The flap, *b, c, c, f*, should be raised to the level of the commissures *a* and d.

PLATE XLV.

HARELIP, ETC. (*Continued*).

Figs. 1 & 2.—*Malgaigne's method of treating harelip.*

Fig. 1.—Two incisions, *a* and *b*, detach two little flaps from the edges of the fissure, which are turned down, that their open surfaces may be opposed, the object being to prevent the little gap which remains after the ordinary operation, at the edge of the lip.

Fig. 2.—*The two flaps turned down before the application of the sutures.*

Figs. 3 & 4.—*Method adopted by M. Mirault, of Angers.* —A flap, *a*, on one of the borders of the fissure, is preserved. This little flap is intended to fill up the gap at the edge of the lip.

Figs. 5 & 6.—*Contraction of the buccal orifice.—Dieffenbach's method.*

Two incisions, *a*, *b*, and *c*, *d*, through half the thickness of director is passed through this opening to guide the cutting instrument (bistoury or scissors) in order to form the new mouth. The two raw surfaces are to be then covered with linen and simple cerate, to prevent contact during cicatrisation.

When the contraction of the buccal orifice is produced by vicious cicatrices, resulting from burns or ulcers, it is more difficult to obtain a good result than in cases of abnormal adhesion. The process of cicatrisation brings about new adhesions which re-establish the contraction. To prevent this re-establishment of the deformity methods have been devised which we are about to describe.

Berger's method.—The buccal orifice being formed by two incisions carried as far as requisite—but in all cases ceasing inside the labial arteries—the two commissures are pulled apart by two blunt silver hooks, acting in opposition to one another. A suitable bandage fixes the two hooks at a proper distance from one another while the lips cicatrise. This procedure has been successful in some cases.

It has also been proposed to make a trocar puncture at the site of each commissure, then passing a leaden wire through each puncture, to twist up the ends day by day until the included skin, etc., are cut through by the gradual tightening. But there is danger that the divided tissues will cicatrise and unite behind the wire loop.

Krügen Hansen's method.—The leaden wire is here not intended to *cut* the tissues, it is left in place without being tightened, and when the little holes first made are cicatrized and converted into permanent apertures, the buccal orifice is completed by the bistoury, the two cicatrised perforations forming the commissures. By this procedure the results of the healing process are less to be feared than in the former case. Instead of the leaden wire a little silver canula might be used, or Scarpa's leaden style, the head of the style being in the mouth, and the bent point outside on the skin.

Dieffenbach's operation (Plate XLIV., *bis.*, figs. 5, 6).—To prevent the reunion of the edges of the wound this surgeon devised a mode of operation by which the buccal mucous membrane is preserved, so as to re-cover the raw surface of the newly-formed lips.

The operator passes into the patient's mouth the index finger of the left hand, to fix the cheek, the other hand, carrying a sharp-pointed pair of scissors, or better, a straight and very sharp bistoury, introduces the point of the instrument a little above the intended labial commissure ; the blade must not perforate the cheek, but be passed from without inwards, halfway through the tissues, till it reaches the contracted buccal orifice. When the point appears, turn the blade with its edge forwards, and cut at once from behind forwards the entire superficial half of the tissues. A second incision is made in exactly the same manner just below the first, and these two incisions are connected by a semilunar cut just at the point where the new commissure is to be. It only remains to cut out the triangular flap *a*, *b*, *c*, *d*, contained between the incisions, taking care to avoid cutting the mucous membrane which forms the floor of the wound.

The second step of the operation consists in utilising the said mucous membrane. It is to be separated as much as if an adult, may be operated on while sitting in a chair, his head slightly thrown back, and supported by an assistant. If the patient is a young child, he must be wrapped in a sheet and entrusted to an assistant who holds him on his knees. The assistant, whose duty it is to support the head, should press the patient's cheeks as much forward as possible, and compress the facial arteries on the upper jaw in front of the masseters. The operator begins by raising the upper lip to divide with a bistoury or scissors the frænum which binds it to the gum. The angle of the left edge of the fissure is then seized with forceps or with the fingers and drawn downwards and forwards; then, with strong and yet slender scissors, the whole red margin of the fissure on one side is removed at one cut, extending to $\frac{1}{12}$ of an inch above the fissure. The right margin is then excised by a similar cut, which is made to meet the upper extremity of the first incision. These two incisions then form an inverted V, whose limbs enclose the harelip. Both lips should be freely severed from their deep attachments, to enable them to be brought together without tension.

2. *Union.*—The two raw surfaces of the wound are next brought together and joined by two or three points of twisted suture in this manner: the lower angle of the left flap is seized as before the first incision, and is transfixed obliquely from below upwards, and from without inwards, by a pin which passes in at the mucous edge of the lip, and out at the raw surface. The pin should appear at a point between the two anterior thirds and posterior third of the thickness of the lip, entering $\frac{1}{8}$ of an inch external to the fissure, and making its exit in the wound $\frac{1}{8}$ of an inch above the mucous edge of the lip. The angle of the other flap is next pierced by the pin, but from above downwards, and from within outwards, entering at the wound and coming out on the mucous surface of the lip.

The first pin describes a curve whose concavity is below, in order to make the two angles of the fissure project downward—to prevent, as much as possible, the little gap which almost always remains in the edge of the lip. Some surgeons instead of passing the first pin through the mucous edge of the lip, pass it through the skin a little above.

The first pin being in place, and the apposition of the flaps maintained by the help of a thread applied like the figure 8, the second pin is passed horizontally at a little distance above the first. Then the third pin is placed a little above the second (see Plate XLIV., fig. 2). Between the pins it is well to place slips of plaster to draw the cheeks forwards and support the sides of the wound. Lastly, the points of the pins are cut off and the skin protected by small strips of plaster from contact with their ends (see Plate II., fig. 6). A simple dressing of simple cerate on linen and a little lint will complete the affair.

During the first few days the patient should be kept as much as possible alone, to prevent any tendency to excitement, either to crying or laughing, which by traction on the flaps would endanger the union of the wound. Fluid nourishment should be allowed only; and if the patient is an infant, it should be fed with a spoon. The wound should also be carefully watched in the case of an infant who might suck in and swalthe lip becomes horizontal. These flaps are only held by their pedicles, which allow them to be inverted, being turned down till their raw surfaces are in contact. The first pin, which should be a strong one, is passed at the base of the lip, to bring into contact at once the two retreating angles produced by the turning down of the flaps. Then one or two pins are placed above the first. The body of the lip is thus united, and it remains to give its edge a suitable form.

"To accomplish this press together the pedicles of the two flaps. Sometimes the incision has not gone low enough; the flaps, when turned down, do not lie in the same horizontal line as the edge of the lip; the incision must then be prolonged until a good line of lip is obtained. Then, with scissors, cut off all unnecessary length of the flaps, leaving only that which is essential to filling the gap up well; it is as well to keep a little too much to allow for retraction of the cicatrix. They are fastened together either with entomological pins or with interrupted sutures. If the harelip do not extend the full height of the lip, it will be well to prolong the incisions towards the nostril, to make exact adaptation at the upper end of the wound. If the labial frænum comes down too low, it should be divided."—*Manual of Operative Surgery.*

Operation of M. Mirault d'Angers (Plate XLV., figs. 3, 4).—One of the edges of the fissure is completely stripped; but on the other side a pedunculated flap is left at the lower angle. When the edges are brought together, the said flap comes in to prevent any notch.

Mr. Francis Mason, in an interesting and full article on Harelip in the *St. Thomas's Hospital Gazette* for 1875, remarks:—"It is of importance thoroughly to free the lip from the jaw on each side, so that the edges of the wound may be brought into contact without any strain on the pins or sutures, and in doing this the surgeon should remember to apply his knife quite close to the maxillary bone, for in so doing the risk of hæmorrhage is diminished. Moreover, a sufficient quantity of the edge of each cleft should be taken away. As a rule too little is removed; hence an unsightly vertical dip is left. Then the incision should be made somewhat concave, with the concavity directed towards the fissure, and a sufficient amount of the prolabium should be taken away, which obviates the V-shaped dip so often noticed after the operation."

Double harelip (Plate XLIV., figs. 3, 4).

When the central tubercle is so small as to be removable without inconvenience, it is simpler to excise it, and complete the operation as in simple harelip. But if the median tubercle must be kept, then its edges must be pared as well as those of the outer borders of the fissures. Apposition is obtained by pins passed through the outer flaps and central tubercle. The cicatrix has the form of a V or a Y. It may be that the central piece is too large for a single pin to go through both wounds at once, in which case twisted sutures may be used in each branch of the V. The notch remaining in the edge of the lip is larger in these cases than those of simple harelip; and modifications of Malgaigne's and Mirault's operations may be employed to meet this defect.

thod be adopted, the harelip operation must be delayed until the intermaxillary bone is set aright.

Blandin, with strong scissors, cut out a triangular piece from the base of the septum nasi. The intermaxillary, deprived of its support, could then be pushed back into place.

3. *Abnormal connection of the labial tubercle* (attachment to the tip of the nose) occurs often, with projection of the osseous tubercle supporting it. In this case the labial tubercle is to be utilised to form the division between the nostrils.

Dupuytren with a bistoury divided the adhesions which united the labial tubercle to the osseous tubercle, removing from this latter all that projected beyond the upper jaw. Then the cutaneous tubercle has its edges pared, the edges of the fissure are also pared, and the treatment proceeds as in simple harelip. The cutaneous tubercle is then bent up, and kept in position under the nose by suture.

4. *Cleft palate.*—*Phillips* has operated as follows where the bony fissure has interfered with the treatment of a harelip. He passed a silver wire through the base of the nose behind the alæ, small plates of cork having been placed on each side of the nose, and being traversed by the silver wire. The wire is then bent over the corks, which serve as points of support, and the nose is thus fixed between two buttons, which throw together the parts whose separation hindered the process of union.

Removal of cancers of the lip and cheiloplasty.

Cancroid excrescences and superficial tumours growing from the free edge of the lip may be cut off with scissors curved on the flat. The little tumour is seized and raised with forceps, and then cut off, care being taken that some sound tissue is removed with it. The wound generally heals readily.

Cauterisation may be employed as well by covering the wound with arsenical paste or other caustic.

Larger tumours, involving a greater depth of tissue, should be limited by two incisions, made with scissors or the bistoury, in the shape of the letter V. After the ablation of the tumour, the edges of the V-shaped wound are brought together by suture. This operation is, however, only suitable for tumours of a moderate size. It may happen that difficulty is found in bringing the wound together; in that case it will be necessary to dissect up the edges of the wound from the subjacent parts in order to oppose them more easily. Large and irregular tumours will demand special ingenuity and skill on the part of the surgeon. The removal of these tumours will involve loss of substance, which can only be made up by cheiloplastic processes.

Cheiloplasty of the lower lip.

The Italian and Indian methods are now abandoned. Whatever method may be used, a most important indication is to keep as much mucous membrane as possible to cover the new lip.

Chopart's operation (Plate XLIV., fig. 6).—The tumour is isolated by two parallel vertical incisions commencing at the fore edge of the lip, and going down to the sub-hyoid region.

low as the sub-hyoid region, the extent of the wound being proportioned to the loss of substance which must be made up. The skin of the chin forms, in this case, a mobile pouch in front of the lower jaw—a veritable apron, which can be raised to the level of the lip; it is to be kept in position by adhesive strapping and bandages until cicatrisation is complete. If the tumour extends to the cheek, the buccal opening is extended by cutting the angles of the mouth, and bringing one of the extremities of the semilunar incision up to meet it.

Morgan's operation.—To render the dissection of the flap which is to be raised easier, Morgan has modified the preceding operation by cutting through the integument vertically downward from the centre of the semilunar incision. We thus have two flaps, easily dissected up, and which can be brought up to the level of the commissures, and united in the middle line by suture.

M. Malgaigne's operation.—All the diseased parts should be taken away at once, either by a V-shaped incision or by two vertical incisions descending as low as the lower edge of the maxilla, connected there by a transverse incision. In the first case the lost substance is in the shape of a triangle; it will then be convenient to prolong the angles of the mouth on each side by a transverse incision, and to dissect up two triangular flaps. The vertical edges are then to be brought together in the middle line by means of sutures; the upper edge of the flaps is disposed of thus: part is wanted for the lip, and the remainders on each side are to be stitched to the upper edge of the horizontal incisions.

"In the second case the lost structure is four-sided, and to the incisions springing from the commissures two others must be added, extending down to the lower edge of the jaw. We can thus dissect up two four-sided flaps, which are joined in the middle line, and to the edges of other incisions, where suitable points can be found.

"The result of this proceeding is that the cheeks alone contribute the tissues for the lip, whose free border is formed by the raw surface of the horizontal incision. Consequently the new lip contains muscular fibres belonging to the orbicularis and its antagonists; it is covered behind by natural mucous membrane, and sometimes the free edge of the lip is covered with mucous membrane by Diffenbach's method."—*Manual of Operative Surgery.*

It is rarely necessary to practise cheiloplasty of the upper lip. Losses of tissue are made up by flaps borrowed from the cheeks: the nature of the case will indicate the operative measures needed.

Genoplasty.

"When the operation is called for by inconsiderable lesions, the surgeon confines himself to paring the edges of the wounds and dissecting them up from the surrounding tissues, then bringing them together with sutures."—*Roux.*

If the loss of substance is too great to be repaired in this way, it will be necessary to borrow a flap from the cervical region, and restore the cheek by the Indian or French method.

The operation must depend on the size and situation of the diseased parts; and the surgeon will be guided by the general principles laid down in treating of blepharoplasty and cheilopattern of the lost nose with wax or paper. This pattern is next laid on the forehead, base upwards; its exact outline is traced with ink on the skin, and the operator dissects up that skin, ¼ of an inch outside the tracing. The dissection is to be carried as far as the root of the nose, taking great care that the pedicle, *d*, is left large enough for the nutrient vessels not to be compressed. The flap is twisted on its pedicle in such a way that the raw surface is towards the nasal fossæ, and its edges are stitched to the previously pared edges of the lost nose. To keep the nostrils open, and support the new structure, may be inserted in the nostrils some plugs of lint, or pieces cut from a gum elastic band, *e*, *e*. When union has taken place the sutures are removed, and the pedicle cut through on a director, to remedy the torsion. The wound in the forehead will cicatrise, and only calls for the simplest dressings.

Delpech's method.—This consists in cutting a flap with its base, as represented in fig. 1, with three points, *a*, *b*, and *c*. The two lateral parts form the alæ nasi, and the median point, *b*, constitutes the separation of the nostrils.

Lisfranc, wishing to avoid twisting of the pedicle, which might lead to gangrene of the flap by interfering with the circulation, advised that one of the incisions should be carried lower than the other, and twisted the flap to the side of the longer cut. But the advantages to be obtained from this step do not always make up for the inconveniences which may arise from carrying incisions too near to the injured part whose substance is to be restored.

2. *The Italian method.—Græfe's operation.*—This is but a modified form of the operation described and performed in Italy by Tagliacozzi. As the new nose has to be borrowed from the skin of the arm, the patient should be accustomed for some time before the operation to the fatiguing position which must necessarily be maintained during cicatrisation.

The second figure in Plate XLVI. shows the kind of bandage which the patient will have to bring his mind to endure while the arm is kept up to the face.

A flap, nearly six inches long by four broad, is marked out on the arm, and dissected up in such a way that the root of the nose and the lateral parts can be fixed directly by sutures to the edges of the facial wound, while the base remains adherent to the arm. Union in the opposed edges having taken place, the base of the flap is cut across and the arm released. This base of the flap is then to be cut into the three-pointed shape directed in Delpech's operation.

Tagliacozzi dissected up the flap, and let it suppurate before he fixed it to the face. He thought that the suppurative process caused the flap to become more fleshy, and rendered it more suitable for the purpose in view.

3. *French method.*—This consists in making up for lost tissue by borrowing new substance from the adjoining parts. It has been already described under the head of Blepharoplasty (Plate XXXVII).

The steps of this operation, which is especially adapted for the repair of partial loss of the nose, cannot be described with exactitude. The alæ nasi can be restored by a flap taken from the cheek; the cartilaginous septum by skin from the upper lip, care being taken not to use more than half the thickness of the lip, and to leave the mucous membrane intact.

Foreign bodies in the nostrils.

Two routes are open for extracting or expelling foreign substances—the one in front through the nostrils, the other backwards into the pharynx. The size and character of the body and the depth at which it lies in the nasal passages will tend to indicate what course to pursue. Forceps may be employed as in the extraction of bodies from the auditory meatus, or it may be practicable to push it into the pharynx. In cases where simpler treatment fails, we may bring it forward to the nostril by means of a pledget of lint (used as in plugging the nose from behind).

Polypus nasi.

The surgical treatment of these polypi depends on their nature, seat, and form. Classified according to their nature we have:—1. Soft, or mucous polypi. 2. Vascular polypi. 3. Hard, fibrous, cartilaginous polypi. 4. Fungous or cancerous.

1. The *mucous polypi* are commonest and of least importance; they are formed of greyish matter, sparingly vascular, and often consisting of vesicles containing serous fluid. They are generally pediculated and non-adherent, and are therefore easily removed by twisting. They generally spring from the upper or outer walls of the nasal fossæ.

2. The *vascular polypi* are rich in blood-vessels. They are often very large, and push out the bony walls which confine them and oppose their expansion.

3. The *hard fibrous polypi* are less common than the preceding, and consist of a dense tissue almost devoid of vessels. They may absorb the bony walls, and they may have tough pedicles of some length, the point of origin being at a distance from the bulk of the tumour.

4. Under the names of *fungous* or *malignant polypi* are described the sarcomatous tumours.

The *operative measures* usually employed at the present day are:—1. Cauterisation; 2. Torsion; 3. Evulsion; 4. Excision and Ligation.

1. *Cauterisation.*—Solid or fluid caustics of all kinds may be used. Sulphuric acid, acid nitrate of mercury, butter of antimony, etc., may be applied with a brush. A small specu-

lum should be employed to protect the sound tissues from contact with the caustic, and the applications must be repeated more or less frequently, according to the extent and nature of the malady. Under the name of *Kusck's* caustic a mixture of sulphuric acid, butter of antimony, and nitrate of silver has been highly thought of in Germany. Nitrate of silver and the red-hot iron are sometimes efficacious; the latter is especially applicable to mucous polypi, which are to be reached in the pharynx, but it is not to be passed into the nose without extreme care, as inflammatory results may arise, and may extend to the brain.

2, 3. *Torsion and evulsion* are often combined. They are accomplished by means of polypus forceps. It is advantageous to use very strong forceps, the blades of which are armed with teeth from the joint to the tips, so as to seize firmly the bulk of the tumour. Curved forceps are employed to reach polypi from the posterior nares. The patient is seated in a chair opposite a window, the head being thrown back and supported by an assistant; the surgeon opens the nostril with one hand and with the other introduces the forceps with the blades closed

Hard and large-sized polypi often require such forceps as can be disjointed, each limb being passed separately; sometimes to effect extraction the orifice must be enlarged by an incision into the edge of the nostril or upper lip; or sometimes the soft palate must be cut through.

When polypi are approached by the posterior nares the tumour must be pushed back by the little finger passed through the nostril, and the forceps used must necessarily be bent.

Hæmorrhage will perhaps occur after the operation. Astringent injections are usually sufficient to meet this difficulty; if not, then plugging must be resorted to.

4. *Excision* is chiefly applicable to pediculated polypi situated near the nostrils. Fibrous polypi, with large pedicles, and inaccessible to the ligature, should also be excised.

This operation is performed either with scissors or with a probe-pointed bistoury. The polypus having been seized with forceps or a vulsellum is drawn as near as possible to the nostrils and firmly held in position while the cutting instrument divides the attachment.

Wately succeeded in removing a large and deep-seated polypus by first passing a ligature round the pedicle; one of the threads served to guide a sheathed bistoury, having an eye near its point, through which the thread was passed. The instrument, thus led up to the pedicle, excised the tumour. In all cases we make choice of such scissors or knife as by its shape will best suit the case in hand.

5. *Ligature.*—Ligation has three principal steps:—1. To pass a loop of thread, silk or wire, through the nostril into the pharynx, or *vice versâ*. 2. To place the loop round the pedicle which it is to strangle. 3. To complete the constriction by means of a knot fastener.

First Proceeding.—A properly curved forceps can be passed through the nostril backwards into the pharynx, where the two ends of the wire or thread, passed into the mouth, will be seized by the jaws of the forceps and by them withdrawn from behind forwards through the nostril. Or a sound with an eye carrying a loop of thread can be passed through the nostril into the pharynx, where the thread may be taken by the fingers or a pair of forceps.

Or, lastly, Belloc's canula (Plate X., fig 15) affords a more sure and prompt means than the preceding. It is to be used as in plugging.

Second proceeding.—The loop of thread or wire is to be passed round the pedicle in such a way as to prevent it from slipping, using either the fingers or a fitting instrument so constructed as to expand the loop to such a size as will allow it to pass easily over the tumour.

Third proceeding.—The loop being well placed and drawn tight, the operator removes the last instrument to make use of the knot-fastener. The thread is tightened every day until the separation of the polypus, which usually happens on the eighth or tenth day.

Plugging the nose (Plate XXXVIII.).

This operation should only be used in case of hæmorrhages which resist ordinary means. Cold or astringent injection, cold affusions on the back and head, foot and hand baths, should all be tried first. If the bleeding persists, we must plug. The operation does not procure direct compression on ing out of the nostrils, and serves to keep in place the pledget of lint after the insufflation of the bladder; a little peg stuck into the tube prevents the escape of air and keeps the bladder distended.

The ordinary operation is commenced by making a plug with a roll of lint which shall block up the posterior nases. It is then tied in the middle of a piece of strong silk about 18 inches long. Belloc's sound is then passed through the nostril (or else a very flexible gum elastic catheter is used). The instrument having reached the pharynx, the button is pushed in, or the end of the catheter is seized with forceps and drawn forwards through the mouth, and to the end protruding from the mouth the threads attached to the plug are tied; next the instrument is withdrawn from the nose, and in drawing the thread through the nose a small plug is first pulled into the posterior nares, completely closing it, and then the thread in front is used to tie a plug into the anterior nares. The nasal openings are thus effectually stopped up, both behind and before, and the arrangement may be left for two or three days.

The anterior fastening is then cut, and the posterior plug may be either seized by curved forceps passed through the mouth or pushed back into the pharynx by means of a probe passed through the nose.

OPERATIONS ON THE FRONTAL AND MAXILLARY SINUSES.

Perforation of the frontal sinus.

Trephining of this part may be required in cases of fracture, caries, necrosis, abscess, foreign bodies, and polypi. A semilunar incision whose concavity looks upwards and inwards is made at the level of the upper edge of the eyebrow; the flap is raised, a small trephine applied. The operation is always a serious one, and to heal the fistula which frequently results we have recourse to compression, or to autoplasty.

Catheterism and perforation of the maxillary sinus.

Catheterism.—The opening into the sinus is situated above the inferior turbinated bone, *a* (Plate XLIII., fig. 1), and below the middle bone, *b;* to reach it one uses a little curved probe, slipping it under the middle bone, and about half-way along it the probe will reach the opening into which it is to be passed.

Jourdain has succeeded in curing retention of mucous by means of emollient injections. If the orifice of the sinus cannot be found, or if it is stopped up, an artificial opening may be made with a curved trocar, perforating the bony wall of the sinus under the middle turbinated bone, from within outwards. Jourdain's method is not often adopted.

Perforation of the sinus is the treatment generally adopted, and there are three or four methods of doing it. *Lamorie* entered the sinus between the zygomatic process and the third molar tooth. *Desault* operated in the canine fossa after cutting through the cheek. Desault's operation has been modified; the gum is incised and the perforation is made ¼ of an inch or so above the gingival margin. The wound bears no visible scar. *Cheselden* opened the sinus through the mouth. All these proceedings have their advantages and inconveniences; certain special cases may call for their employment, but the following proceeding is that which is generally preferred :—

PLATE XLVII.

LIGATURE OF A NASAL POLYPUS.—REMOVAL OF TONSILS.

Fig. 1.—*Vertical section of face from before backwards.*—*a*, loop of thread passed round a nasal polypus by means of M. Chaussier's *porte ligature.*

Fig. 2.—*Anatomical position of the tonsils between the pillars of the fauces.*—*a*, tongue ; *b*, *c*, tonsils.

Fig. 3.—Tonsil seized with vulsellum forceps, *a*, is cut off with a probe-pointed bistoury, whose cutting edge is covered with tape.

Fig. 4.—*a*, tonsil removed by the guillotine, *b*.

PLATE XLVIII.

CANCER OF TONGUE AND OPERATION FOR STAMMERING.

Fig. 1.—*Anatomy.*—Arrangement of lingual arteries, *a* and *b*. Hypoglossal nerve, *c*.

Fig. 2.—The cancerous portion is seized with clawed forceps, *d*. Two incisions, *a b*, *c b*. forming a V, whose apex is in the middle line, bound a triangular flap which bares a wound whose edges are brought together by two sutures (fig. 3), *a* and *b*.

Fig. 3.—*Sutures.*

Fig. 4.—The cancerous portion is comprehended between two ligatures, *b*, *c*, and *b*, *a*, which are drawn tight by means of two beaded ecraseurs, *c*, *c*.

Fig. 5.—*M. Vidal's operation.*—A straight needle, *a*, mounted in a handle is passed in above the hyoid bone, *b*, and transfixes the tongue from below upwards ; *c*, loop of thread carried up by the needle.

Figs. 6, 7, 8.—*Same operation.*—*Transverse section of tongue to show the courses the needle ought to take.* Fig. 6.—*a*, needle. One end of the thread, *b*, pulled out—the other end, *c*, hangs down outside. Fig. 7.—The needle, *a*, *a*, has been withdrawn and passed into the tongue again, laterally, so that the point appears at the edge of the diseased organ; the extremities, *b*, *c*, of the thread are drawn out. Fig. 8.—The two ends of the thread, *a* and *b* (whose loop, *a*, embraces half the tongue), are drawn together by the ecraseur, *c*.

Fig. 9.—*Section of genio-glossi.—M. Baudens' operation.*—A tenaculum, *a*, is fixed in the mucous membrane, and the maxillary origin of the muscles cut through with scissors carried on the flat.

CANCER OF THE TONGUE.

OPERATIVE MEASURES.

Before having recourse to such operations as remove part or the whole of the tongue, the surgeon must remember that certain tumours are wholly superficial, and that it is then sufficient to decorticate the tongue to take away the morbid tissues—that in other cases encysted tumours seated in the [redacted]

For a cancer only affecting half the organ, Mayor transfixed the organ near its base, with a bistoury, which was then carried forwards, splitting the tongue. The diseased part was then strangulated by means of a ligature. One could, without any incision, include the diseased tissue between two ligatures (fig. 4).

M. J. Cloquet's operation.—In a case of cancer which had affected the whole of one side of the tongue, and had so extended about the base that ligation could not be performed by the mouth, Cloquet adopted the following mode of operating. A curved needle in a handle, having the eye at its point, was passed in at the middle line of the neck, above the hyoid bone, and transfixed the tongue from below upwards.

The eye of the curved needle—by means of a rocking movement imparted to the handle—is made to appear in the mouth; two ligatures are then passed through the eye. The operator then withdraws the needle, and with it the threads, so that one end of them remains in the mouth, and one end is hanging out of the wound in the neck.

The needle is passed again through the neck wound ; but this time it is made to issue at one side of the tongue instead of penetrating it, where the eye receives the ends of the first threads which had remained in the mouth. The needle, again withdrawn, brings out these last threads through the neck wound. The ligatures thus introduced are employed, one to constrict half the tongue (transversely), the other, received into a vertical slit in the middle of the tip of the tongue, completely isolates and strangulates the cancerous tissues.

The operation of M. Mirault d'Angers is a modification of Cloquet's. The needle is passed first upwards through the tongue, and then downwards at one side of the organ.

Vidal's operation (figs. 5, 6, 7, 8).—This is the author's own description of his operation:—" I use a large straight needle in a handle (fig 5, *a*). It has a spear-headed point, with an eye. If only half the tongue is to be removed, a single very strong thread is used. The tongue being held by its tip and drawn forward as far as possible, the needle is introduced just above the hyoid bone, *b*. The farther back the disease has gone, the farther back the needle must go. Having passed it upwards through the tongue—the point appears in the mouth with the loop of thread it carries, *c*, the two ends hanging out of the neck, held by an assistant. The surgeon takes the needle handle in his left hand, and with forceps draws one-half the loop out of the mouth, giving it to another assistant (fig. 6, *b*). There is now one thread in the neck wound, *c*. The needle is then half withdrawn until the point has reached the base of the tongue, when it is pushed upwards and outwards, and the spear-head appears between the anterior pillar of the fauces and the edge of the tongue (fig. 7). With the forceps, the end of thread which had hung from the neck is drawn out of the needle-eye, and the instrument is completely withdrawn. The two ends of the thread are tied or passed through a *serre nœud*, *c* (fig. 8). If the cancer occupies the whole tongue, a double ligature is made to encircle both halves of the organ. Then two threads are passed through the needle eye—one black and one white—the difference of colour rendering the constriction of each side more easy of accomplishment."

a finger of his left hand in the mouth just above the genial tubercles; then, with a sharp tenotomy knife in his right hand, he pierces the skin, in the middle line under the chin, and passes the knife through the inter muscular space of the digastric and mylohyoid. The sharp knife is then replaced by a blunt one, which is carried through the wound, its edge turned forwards, until the finger in the mouth feels the point of the blade; then turning the edge to each side successively, the surgeon cuts through the attachment of the genio-glossi. Before completing this step, he should be sure that the knife is between the tubercles, and not touching the buccal mucous membrane. After the operation a considerable effusion of blood may take place, causing some trouble in deglutition for three or four days.

The results of these operations have been so often disappointing that physicians prefer to try *gymnastic* exercises, as those of Colombat Serres, and others.

SECTION OF THE FRÆNUM LINGUÆ.

If it extends too far forward the frænum is troublesome to the new-born infant in sucking, and in later years it impedes speech. Before cutting the frænum, it should not be forgotten that the ranine veins run under the tongue on each side. The infant is placed on the knees of an assistant, who holds the child's head back, and pinches his nose to make him open his mouth; the surgeon lifts the tongue with the thumb and finger of the left hand to stretch the membrane; then with scissors, curved on the flat, he makes the incision, as far as possible from the tongue, and with the points of the scissors turned downwards, away from the ranine veins. To raise the tongue the split flat end of a director may be used. The wound requires no special attention.

Two accidents are to be feared in this operation :—(1) The tongue being turned back into the pharynx, which might cause suffocation; (2) hæmorrhage, when the vessels are wounded. In the first case the index finger can set the tongue right; in the second case, one has recourse to astringents or cauterisation by wire heated to whiteness, or the wounded vessel may be closed with a ligature.

We sometimes see in young infants sublingual tumours in the form of a fleshy pad. They may be removed by excising them with curved scissors.

ABNORMAL ADHESIONS OF THE TONGUE.

These may be congenital or acquired. In the first instance they appear as bridles of cellular tissue, easily divided with scissors; in the second they are often the result of suppuration; they are then extensive, and sometimes are very tough.

The patient is seated in a chair, the head thrown backwards, the mouth kept open by a cork between the molar teeth; the operator, standing behind the patient, separates the buccal wall and the free parts of the tongue, and then with a bistoury divides the adhesions. The operation is stopped now and then to allow the patient to use astringent gargles.

The wound cicatrises of itself. To avoid fresh adhesions, the patient is advised to move the tongue frequently, and to pass the finger between the cut surfaces.

Excision of the uvula.—The patient being seated in a chair, and held as in the operation for removal of tonsils, the operator times in the treatment of this affection; but they have almost entirely given place to excision. It is done either with tonsil forceps and a probe-pointed bistoury, or with guillotines invented for the special purpose.

Excision.—The patient being seated opposite the light, with his head leaning against the chest of an assistant, who keeps the jaws open by means of a wedge-shaped cork placed between the teeth; if the assistant is in front of the patient, he will keep the tongue down with a spatula or handle of a spoon. The operator stands before the patient, and seizing the tonsil with the vulsellum forceps, draws the gland from between the pillars of the fauces, and slightly forwards, thus making it more prominent, and at the same time farther from the carotid artery. In the disengaged hand he holds a probe-pointed bistoury, whose edge is protected by being bound with tape to within an inch and a half of its extremity. Bringing the blade parallel to the wall of the mouth, under the tonsil with the edge upwards, the operator cuts off the hypertrophied gland. As a rule, it is best to remove as much of the tumour as possible. The operation is rarely followed by much hæmorrhage, and astringent gargles, or powdered alum placed on the wound, will stop it, if it occurs.

Should there be any reason to fear bleeding, on account of the large size of the gland, or of any abnormity of growth, the operator must take the precaution to have an iron heated to whiteness, in readiness to apply to the wound. It has been said that deep inspirations help to check bleeding from these parts.

Should the carotid artery be wounded in the operation, the operator will at once compress the common carotid with his fingers; at the same time a plug of lint fastened to one blade of straight forceps is applied to the bleeding spot, and the other blade is placed outside the cheek to form a point of support; the two rings in the handles are then securely tied to each other, thus exercising pressure sufficient to stop a slight bleeding, or control a more severe one while the artery is tied.

It is unnecessary to describe here the instruments specially devised for this operation. By Fahnestock's tonsillotome modified by Velpeau the tonsil is made to pass through its two rings, and fixed by a sliding prong (single or double), or by a twisted claw; it only remains to make the rings slide one over the other, in order to cut off the redundant gland. These instruments, which are certainly very ingenious, will be used with advantage in the case of infants; but have the inconvenience of not being applicable to all cases, and effect only an incomplete excision. The bistoury operation is therefore generally preferred (Pl. XLVII., fig. 3, *a*, *b*).

PLATE XLIX.

OPERATIONS ON THE SALIVARY APPARATUS.

Fistula of the Parotid Gland and Steno's Duct.

Anatomy.

Fig. 1.—*The parotid gland*, *a*, whose shape is almost pyramidal, is bounded above by the zygomatic process and maxillary articulation; behind by the sterno-mastoid muscle; it lies over the mastoid process and the digastric muscle. It surrounds the internal maxillary artery, and sends glandular processes into the condyloid fossa and beneath the temporal bone, its deep or have often caused facial paralysis by dividing branches of the nerve.

The external carotid artery, *c*, almost always runs up through the deeper part of the gland.

The temporal artery, and its important veins, also pass through the gland in different directions.

Do not these anatomical data show how difficult and dangerous an operation is extirpation of the gland?

Steno's duct, *b* (figs. 1 & 2), passes horizontally forwards upon the masseter, in a line drawn from the *tragus* to the angle of the mouth; at the anterior edge of the masseter, it changes its course and passes perpendicularly into the substance of the cheek, going through the buccinator; and after a short oblique course between this muscle and the mucous membrane it opens in the mouth almost exactly opposite the separation between the first and second molar. This canal is accompanied by branches from the transverse facial artery, and by a branch of the facial nerve.

The submaxillary gland, *c* (fig. 1), is placed under the body of the lower jaw, in relation with the fossa which bears its name; it is covered below by the cervical fascia, and the platysma. Within it is related to digastricus, mylohyoideus, hyoglossus, and the lingual nerve. The most important of its relations is with the facial artery, *d* (fig. 1), which passes through a groove on its upper and inner surface.

Wharton's duct, *b* (fig. 1), arises in the gland, and opens by the side of the frænum linguæ.

Fig. 3.—*Morand's operation.*

Fig. 4.—*Horizontal section of fig*. 3.—*a*, upper row of teeth; *b*, Steno's duct; *c*, fistula; *d*, angle of mouth; *e*, seton tied outside the mouth.

Fig. 5.—*Deguise's operation.*

OPERATIVE MEASURES.

Salivary fistulæ are of two kinds; some, affecting the *parotid* directly, are situated over the gland itself, or over the branches of the salivary duct, while others are caused by lesions of the *duct*.

§ 1. There are various modes of treating parotid fistula :—

1. *Irritating injections*, proposed by Louis, with astringent or caustic fluids.

2. *Cauterisation* with the red-hot iron, or with caustics.

3. *Vesication* has been successfully used by M. Velpeau.

4. *Compression*, proposed by Desault, with the intention of causing atrophy of the parotid. M. Malgaigne, instead of this, attempts to prevent the flow of saliva and favour cicatrisation, by the application of a piece of gold leaf covered with a patch of Burgundy pitch.

5. *Excision.*—Which consists in making two elliptical incisions to remove the edges of the ulcer, and then uniting the raw surfaces by means of sutures.

6. *Extirpation* of the parotid is nowadays seldom attempted on account of its danger.

§ 2. *Fistulæ of the duct* may be treated in many ways; the operations are classed according to their object, *e, g* :—

1. Cicatrisation of the fistulous opening. 2. Dilatation of the natural opening. 3. The formation of a new buccal opening. 4. Procuring atrophy of the gland.

Third Class.—The formation of a new canal.—To accomplish this end, *Deroy* passed a red-hot iron through the cheek, just in front of the masseter. The operation has been modified by later surgeons, and at present the following method is usually adopted.

Deguise's operation.—Fig. 5 represents a horizontal section of the cheek, showing the disposition of the parts concerned; *a* is Steno's duct, *c* the fistulous opening. A trocar is passed into the fistula, and as far as possible along Steno's duct, and then backwards and inwards through the cheek in the direction of *c*, *b*. Two fingers passed into the mouth keep the cheek steady, and enable us to know the point of perforation. The trocar is withdrawn, the canula remaining, and through it a lead wire is passed (*c*, *b*); then the canula is taken out, and with the trocar passed in an opposite direction to the first puncture (*d*, *e*). Then a silk thread is put in through the canula, which is next withdrawn. The silk is intended to be tied to the end of the leaden wire, in order to pull the wire into the mouth in the line, *d*, *e*, that its two ends may be fastened into a ring, *f*, which encircles the soft parts at the bottom of the fistula. It only remains to pare the edges of the fistula, and bring them together with sutures. When the wound has healed, the leaden ring is cut, and the saliva runs through the artificial opening into the mouth.

M. Rona modifies this operation by using silk instead of lead wire. M. Malgaigne uses a strong silk thread with a needle at each end. The first needle is passed into the cheek in the line, *c*, *b*, the second in the line, *d*, *e*. The silk loop then encircles the soft parts, when its ends are tied in the mouth. This operation is as speedy as it is easy.

Fourth Class.—Desault extolled compression to atrophy the gland. *Viborg*—for the same purpose—ligatured the duct. But the result of experience has gone against these procedures, and those of the third class are preferred.

Extirpation of the submaxillary gland (see explanation of Plate XLIX.).

Operation.—A crucial or semi-lunar incision is made through the skin covering the gland. The vessels are tied with two ligatures, and cut between. The gland is seized, drawn out, and isolated from the hypoglossal nerve and lingual artery, by careful dissection. After the operation immediate union may be tried, if the wound allows, or dressing with lint may be employed, leaving the parts to heal by second intention.

RANULA.

Ranula is a tumour developed on each side under the tongue, between the jaw and the tongue, above the suprahyoid muscles. Surgeons are not agreed as to the nature of these tumours ; they are seated either in the sublingual gland, or are produced by dilatations of Wharton's duct, or are encysted tumours of the duct (Jobert). Whatever their origin may be, they sometimes are of such size as to interfere with deglutition, and to call for surgical aid.

Puncture and incision.—The original modes of treatment are nowadays rejected as insufficient.

Cauterisation with the hot iron was employed by Ambrose Paré ; liquid caustics and injections of iodine have been employed successfully, but the resulting inflammation is often severe.

PLATE L.

STAPHYLORAPHY.

Fig. 1.—*Roux's operation.*—The first and second sutures, *d*, *d*, and *c*, *c*, having been put in, the third is placed half-way between them. The free edge of the cleft is held with the forceps, *b*, and the needle held in the needle-holder, *a*, is passed from behind forwards through the margin of the cleft.

Fig. 2.—The three threads, *a*, *a*, *b*, *b*, *c*, *c*, being in position, the operator pares the edges of the fissure with a probe-pointed knife, *e*.

Fig. 3.—Tightening the knots, *c*, *c*, *b*, *b*, with the instrument, *a*, *a*.

Fig. 4.—*Staphyloplasty.—Dieffenbach's operation.*—*a*, *b*, and *a*, *b*, longitudinal incisions made parallel to the edges of the fissure.

PLATE LI.

STAPHYLORAPHY.

Figs. 1, 2, 3, 4, 5.—*Bérard's method.*—Fig. 1.—The operator seizes one edge of the fissure with a pair of forceps, *a*, and passes a loop of thread, *c*, from before backwards with a needle-carrier, *b*.

Fig. 2.—The ligatures, *a*, *a*, *a*, being in position, the surgeon pares the edges of the fissure with a bistoury, *c*.

Fig. 3, 4, 5.—*Diagrams of the above operation.*—Fig. 3.—Passage of the first single thread, *b*, *b*, through one lip of the fissure, *a*, *a*.

Fig. 4.—Passage of the loop of thread, c.

Fig. 5.—The loop of thread, *c*, drawing forwards the end, *b*, of the first thread, *b*, *b*.

Fig. 6, 7, 8, 9.—*Pierri's method.*—Fig. 6.—*Application of the instrument behind one lip of the fissure.*—*c*, movable cap holding a loop of thread, *a*; *b*, hooked needle contained in a canula.

Fig. 7.—*The canula pushed up to the front of the fissure.*—*b*, the sliding-needle at the moment when it is about to pass through the edge of the fissure.

Fig. 8.—The needle, *b*, pushed on by the operator after having traversed the lip and pushed back the cap, *c*, receives in its hoo the loop of thread, *a*.

Fig. 9.—The needle drawing the loop of thread, *a*, forwards.

CLEFT-PALATE.

Operations (Plates L. & LI.).

Cleft-palates are almost always congenital, and appear in three forms.

1. *Simple Cleft-palate*, affecting only the velum palati, is a median fissure without loss of substance, and limited to soft parts.

2. *Incomplete fissure of the palatine arch*, with some osseous separation.

3. *Complete fissure of the palate*, in which the bones and soft parts are completely separated the whole length of the palate. The fissure may reach the lips, and be complicated with harelip (Plates XLIV. & XLV.).

The surgical operations by which these deformities are remedied are:—1. *Staphyloraphy*, in simple cleft-palate. 2. *Staphy-*

patient is seated opposite the light, the head leaning and back supported against the chest of an assistant; the mouth is kept wide open by a cork between the molar teeth; the surgeon in front of the patient, with forceps in his left hand, seizes the right lip of the fissure, and by a needle-holder, *a*, held in his right hand, passes the point of the needle behind the velum, to bring it forwards through the soft-palate, ¼ to ⅛ of an inch from the edge of the fissure. The needle, passed as far as its eye, is loosened by the needle-holder, and its point seized by a pair of forceps drawing it forwards, with the end of thread which is in its eye. After some moments (to rest the patient), the same manœuvre is performed on the left lip with the other needle on the first thread, the two ends of which are now in position. When three sutures are used, the lowest is put in first, then the highest, and, lastly, the third is put in the middle. Fig. 1 shews the introduction of the third suture.

The ends of the threads, *c*, *c*, *d*, *d*, being drawn outside, and the loop which each forms being drawn down in the pharynx, the next stage of the operation is begun.

Second stage.—Paring the edges (fig. 2).—To pare the surfaces which are to be opposed, each margin is seized with the forceps, *a*, held in one hand, while with bent scissors, or a probe-pointed bistoury in the other hand, the edge is cut off from behind forwards, keeping clear of the sutures, *a*, *a*, *b*, *b*, *c*, *c*; then with a probe-pointed bistoury the fragment is separated by an incision carried a little beyond the angle terminating the fissure. The other edge is next treated in the same way, the second incision being made to meet the first, a little beyond the angle of the fissure.

Third stage.—Tying the knot (fig. 3).—M. Roux begins by drawing up the hindmost thread with his fingers, and after a simple knot he hands the threads over to an assistant, who keeps the thread, *b*, *b*, in place with ring forceps, ; while the second thread is made tight, and then the third is treated. The sutures must not be drawn closer than is necessary to keep the edges well in contact, and avoid any separation of the intervals. When all this is done (fig. 4) the threads are cut off near the knots. The patient must be kept quiet and silent, *and abstain from* *solid aliment for two or three days!!!* Anything tending to stretch the velum palati may compromise success. The sutures are not taken out till the third or four day. The lowest had better remain twenty-four to forty-eight hours longer than the others. There are certain faults in this proceeding of M. Roux. The surgeon needs much dexterity, or he will find several inconveniences. It is necessary that the sutures be placed at equal distances apart, and that each suture passes through the palate at the same level—on each side—and that the distance from the margin of the fissure is uniform. Unless these conditions are observed, it is useless to hope for perfect apposition without lapping or irregularity in the wound. And it is easy to understand the difficulty there must be in passing sutures from behind forward, when it is impossible to see the point at which the needle is going to pierce the palate. Paring the edges is difficult when performed from behind forwards with the bistoury; and when using scissors there is risk of cutting the threads. For these reasons the operation has been modified in the methods to be described.

loop is made to receive the end of the first thread, *b*, and draw it back in the direction of the arrow, *c*, as is shown in fig. 5. The other two sutures, being placed in position in the same manner as the first, the surgeon proceeds to pare the edges from below upwards. Fig. 2.—The edge of the cleft is seized with, *b*, the forceps, and the paring is accompanied with the bistoury, *c*.

Velpeau begins by paring the edges before placing the sutures. Other modes of operating are similar to Berard's, but the instruments used are different. To detail all the devices for passing the sutures, or paring the edges more easily, would be wearisome ; but their mechanism explains itself to the surgeon. We will, therefore, only allude to the more established instruments.

Bourgongnon has devised a needle with a movable point with which the puncture can be made from behind. Other needles of the same kind straight and curved have been effectively used for perforating from the front.

Smidt has devised a needle consisting of a steel rod in a handle, curved towards the point in a half circle of about ½ inch radius. The point has not an eye, but is a little expanded, and has a notch in the side to catch a suture in. The thread being attached, the needle is passed from behind forwards through the palate, and when the loop of thread (in the notch) appears in front it is seized, and the needle is drawn back ; the other end of the thread is then attached, and passed through the other lip of the cleft.

Leroy d'Etioles has devised an instrument which makes the three punctures at once and pares the edge at the same time.

Foraytier and *Pierri* use needle-holders, which retain the edge of the fissure while a needle pushed from before backwards through the palate conducts the suture or brings it back. For a description of Pierri's instrument see Plate LI., figs. 6—9.

STAPHYLOPLASTY.

The loss of substance which constitutes cleft-palate is often so great as to render it impossible to bring the edges together by staphyloraphy. We then have recourse to staphyloplasty, which has three varieties.

M. Roux's operation.—In order to make the parts easier of approximation Roux made two transverse incisions on each side of the fissure the length of the palate bones. The rest of the operation is as usual.

Dieffenbach's operation (Plate L., fig. 4).—Dieffenbach made a longitudinal incision on each side, *a*, *a*, *b*, *b*, about ⅓ of an inch from the cleft.

Bonfils cut from each side a flap, which he dissected from before backwards, turned it on its pedicle, and applied over the solution of continuity. The operation, derived from the Indian method, is not so easy as the two former.

PALATOPLASTY.

When the palatine arch is divided by a considerable fissure, we may have recourse to M. Roux's plan of dissecting up the soft parts outside of each set of sutures, separating them from the bones, and thus easily drawing them together. For this purpose M. Roux used little two-edged knives, straight in the blade, but with the blades bent at right angles or nearly so to the shaft.

with lint, close themselves by means of granulations, according to the same process. When the space in the bone is either closed or diminished so much that the cleft in the soft part is considerably lessened, the sewing of the palate may then be undertaken according to the direction already given, and side incisions made in the soft palate before the sutures are put in. The operation may be continued from time to time until the cleft is removed." The late Sir William Fergusson, without being aware that this procedure had been previously resorted to, employed it with considerable success. It is, however, frequently followed by necrosis of the palate bones, which may to some extent be obviated by making a series of small holes with a brad-awl in the line of division of the bone prior to using the chisel, after the manner suggested and practised by Mr. Francis Mason, of St. Thomas's Hospital. The "muco-periosteal" operation attributed to various surgeons is, perhaps, the best, provided the complete thickness of the soft parts be stripped off freely from the bony palate in the direction from the alveolar border towards the fissure. A properly made raspatory should be used, and its edge should not be too sharp, hence it is preferable to the rectangular knives employed by some surgeons.

PLATE LII.

CATHETERISM OF THE AIR PASSAGES AND OF THE ŒSOPHAGUS.

Figs. 1, 2, 3, 4 *represent antero-posterior vertical sections, showing the anatomy of the parts concerned.*

Fig. 1.—*Catheterism of the air passages.—Chaussier's method.* —*a*, tongue ; *b*, floor of nasal fossa ; *c*, laryngeal tube, whose end is in the larynx, *c ; d*, œsophagus.

Fig. 2.—*Catheterism of the œsophagus for feeding the insane.* —*a*, tongue ; *b*, floor of nasal fossa ; *c*, tube with upper end expanded into a funnel ; *e*, pharynx.

Fig. 3.—*Catheterism of the œsophagus.—Baillarger's method.* —The point of the instrument is passed into the upper part of the pharynx, *e ; d*, iron stilette ; *e*, whalebone stilette.

Fig. 4.—Same operation.—The instrument, *d*, passed into the œsophagus *c*; *c*, *c*, *c*, the end of a syringe to inject fluid nourishment.

CATHETERISM OF THE ŒSOPHAGUS.

Anatomy.

The œsophagus is a long muscular tube extending from the pharynx to the stomach, flattened from before backwards, and an inch and a quarter across. This canal lies on the spine; in front lies the trachea, slightly to the left, so that the left side of the neck is usually selected for œsophagotomy. The pharyngeal end is at the level of the cricoid cartilage, and at this point there are often spasmodic contractions which interfere with the passage of bougies, etc.

Operative Measures.

Catheterism of the œsophagus is used for artificial feeding, or for evacuating the stomach; it is also employed to recognize the presence of foreign bodies in the passage, to extract them or done with a view to inject food into the stomach, a syringe is fitted to the outer opening for the purpose (fig. 4). Should the tube have slipped from the pharynx into the larynx, it is indicated (1) by the convulsive cough and suffocative spasm which immediately follow ; (2) the purpling of the face, jugular dilatation, and violent spasms, and the impossibility of articulating a single word on the part of the patient. The last symptom is the most valuable, because it is the only one which does not appear more or less when instruments are passed into the œsophagus. Therefore, let it be a rule to make a patient say some words before any alimentary matter is injected through the tube.

Baillarger's method (Plate LII., fig. 3).—This is especially applicable to the insane, because it allows us to direct the end of the sound with more certainty in a class of patients whose opposition may cause mistakes on the part of the most skilful. This surgeon uses a catheter with a double stilette. One stilette is of iron wire, *d ;* the other, *e*, is of whalebone. The two stilettes passed into the catheter take the curve given to the tube itself ; but the iron wire keeps its curve, while the whalebone tends to become straight. The catheter is passed through one of the nostrils, and when the end touches the posterior wall of the pharynx (fig. 3) the wire stilette, *d*, is withdrawn ; then the whalebone stilette, *e*, acting alone, pushes the bent end of the catheter against the vetebral column by straightening its curve. This action on the part of the whalebone stilette keeps the end of the catheter from the laryngeal opening, and consequently saves the patient from the dangers of a slip.

Blanche's method.—To attain the same end with a more simple apparatus, and one more under the surgeon's control, M. Blanche uses a jointed stilette, in which there is a central stem ending in a ring, in which the operator puts his thumb ; in two other rings the index and middle fingers are placed ; the central stem, being either pushed in or drawn out, imparts to the jointed stilette all the curves necessary for passing the catheter. This very clever instrument enables the surgeon to act with rapidity and precision, and thus spares the patient much peril and distress.

Falert and Ferrus's method.—In the great majority of cases of obstinate lunatics it suffices to convey aliments into the pharynx, when the sensation they produce excites instinctive movements and deglutition is completely effected. Falert and Ferrus have succeeded in feeding unruly patients by means of a female catheter, whose orifice is expanded into a funnel. The instrument is passed through the nose (fig. 2), and fluid nourishment, poured spoonful by spoonful into the funnel, reaches the pharynx through the catheter, and descends into the stomach.

STRICTURE OF THE ŒSOPHAGUS.

The causes which may bring about stricture are numerous, and we cannot here detail them all. When the disorder is discovered, the first thing to be done is to facilitate the passage of alimentary matters into the stomach. Catheterism is then employed with a larger or smaller catheter, which may be left in if necessary. Several forms of dilators have been devised, and cauterisation with nitrate of silver has been used. These measures may be applied to cases in which the malady has been clearly made out.

Dilation obtained by bougies of gradually increasing size, as little irregular and pointed things, like fragments of bone or fish-bones. But it is often necessary to use a sound of some sort to make them pass into the stomach; either a bougie or an ordinary probang may be employed.

Extraction by the mouth.—This may be done :—1. When the foreign body is impacted in the pharynx or commencement of the œsophagus ; it may then be seized with the fingers or with long curved forceps. 2. When the foreign body is arrested lower down, but from its form or its nature cannot be pushed on without danger. The instruments invented for extracting foreign bodies are too numerous to be described here. We shall therefore confine ourselves to showing their mode of action, and to enumerating the most valuable kinds. They are all intended to act from below upwards, and to bring the body into the mouth ; such as hooks which can be introduced, closed between the foreign body and the œsophagus. When below it they are opened in such a way that when drawn up the substance is withdrawn also. In this category may be placed probangs, whose sponge tips are contracted and dry when introduced, which are allowed to remain below the foreign body till they have swollen and then are pulled up. Delahaye's bundles of tow ; Ollenroth's chaplets ; Baudens' umbrella, etc., etc. Dupuytren's prehensive sound is employed in France ; it has at one end a loose hook, which can be easily passed down. Drawing it back, the wings of the instrument fall and catch the foreign body. It is impossible to estimate the relative value of these contrivances in particular cases ; the surgeon will be guided by the nature of the case, and will use the usual simple methods, or will devise something new.

When the methods now described have failed, and by its presence the foreign body is causing inflammation of the œsophagus, the surgeon must resort to œsophagotomy.

PLATE LIII.

LIGATURE OF VASCULAR TUMOURS.

Ballard and Rigal's method.—**The figures shew a section of** the base of the tumours, **to indicate the course of the needles.**

Fig. 1.—*A long and strong thread with three needles.*—***a***, straight and sharp-edged needle ; ***b***, **straight and round needle ;** *c*, curved needle.

Fig. 2.—*a*, base of the tumour ; ***b***, **skin. A vertical roll of** skin has been raised from the level of the upper third of the tumour ; this fold, pierced by the cutting needle and its thread, and then let go, will encircle the upper third with the thread, *c*, *d*, *c*, whose extremities protrude from the skin at the punctures, *c*, *c*. The round straight needle remains for the present outside the tumour.

Fig. 3.—The round needle transfixes the tumour at its base, entering at the point, *e*, and, issuing at ***b***, it brings with it a loop of thread, *g*.

PLATE LIV.

GOITRE LIGATION.

Manec's Operation.

Fig. 1.—Female needle, having an eye, *a*, near its centre.

Fig. 2.—Male needle, with an eye, *b*, at one end to receive a very strong double thread.

Fig. 3.—*a*, *a*, *a*, *a*.—Section passing through the base of a tumour to show the disposition of the needles. The female needle, *b*, is put in first; the male needle, *c*, passes through the tumour and the eye of the female needle.

Fig. 4.—The female needle, *a*, in place. The male needle, *b*, has passed right through the tumour, and the double thread, *c*, *c*, remains engaged in the eye of the needle, *a*.

Fig. 5.—The female needle, *a*, pushed from above downwards, brings the double thread, *c*, *c*, out of the tumour. One of the threads is then cut, and removed from the eye of the needle, *a*.

Fig. 6.—The female needle is pulled back, bringing with it the loop of the thread, *b*, *b*, which is cut, and the needle completely removed from the tumour.

Fig. 7.—The tumour is thus divided into four parts, isolated by four loops of thread, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *j*, *k*, *l*, whose ends are drawn up by four bead ecraseurs (fig. 8, *a*, *b*, *c*, *d*).

GOITRE.

The name Goitre, or bronchocele, denotes enlargement of the thyroid body. It often acquires considerable size, and hinders respiration and swallowing.

In the great majority of cases goitre is only produced by hypertrophy of the thyroid; but it may also consist of erectile, tuberculous, calcareous, cancerous, etc., tumours. Before having recourse to operation, then, it is most important to make out the nature of the disease, that suitable treatment may be first tried.

In general, iodine preparations are of use in simple or recent hypertrophy; puncture would be indicated in the case of serous or purulent cysts. But when the tumour is solid, the operations used in the case of very large goitres ; operative measures, it can render good is preferable to other agents ; but the great care, lest important organs near tl

Setons have been successfully used b Flajani, Maunoir, and Dupuytren ; but t in the case of certain tumours whose n Setons set up suppuration, which causes They would be dangerous if the tumour used they should be passed through eac and the thread withdrawn when the tumc

Ligation of the thyroid arteries.—Thi in erectile tumours, in simple hypertroph development of the thyroid has rendered t Both sides must be tied, for any prospect and Chelius have employed this treatment.

Ligature en masse was first performed Mayor of Lausanne has since described the

Mayor's method.—The tumour is laid ba incision, which permits the skin to be tu left ; then a ligature, consisting of two colours, is passed through the base of the t of each thread are then drawn tight, to str the tumour. If the goitre is of large size could be means of four ligatures acting from the centre of the tumour towards the circumference.

The apparatus needed consists of two straight needles, whose length should be some centimetres greater than the larger diameter of the tumour. One of these needles, called "the female," for simplicity's sake, should be flat, sharp-edged, and pierced at its middle with an eye large enough to be freely traversed by the other, "the male" needle. This last needle has an eye at one end which receives two threads of different colours. The tumour is first transfixed at its base by the female needle, so that the eye of the needle is in the centre of the tumour, and the needle stays there while the tumour is transfixed afresh by the male needle carrying its threads in a direction perpendicular to the direction of the female needle, and through its central eye. Having ascertained that the male needle has passed through the female, the male is removed, leaving the threads running across the base of the tumour and protruding on each side of it.

The female needle is then pushed on until one of the threads in its eye can be seized and cut. Half the tumour is thus divided into two parts, each comprised in a loop of thread. The same proceeding is repeated in the opposite direction to form loops of thread for the other half; and the tumour will thus be strangulated at its base by four ligatures acting from the centre towards the circumference.

Extirpation.—This operation, one of the most serious in surgery, ought not to be attempted except in an extreme case, as when the patient is threatened with suffocation.

The surgical anatomy of the thyroid region shows the perils which attend extirpation of goitres, such as hæmorrhage, and entrance of air into the veins. Few successful results have been recorded; and only under great pressure should the surgeon attempt the operation. Careful attention to the anatomical relations of the thyroid (Plate LV.) will enable the surgeon to avoid some of the vessels and nerves, and thus lessen the danger. The combination of ligation with extirpation as employed by Mayor is the safest.

CATHETERISM OF THE AIR PASSAGES.

(Pl. LII., fig. 1.)

The object of this procedure is to keep up respiration, either by insufflation or with the tube left in, to keep the laryngeal passage open. It is used in œdema of the glottis, in asphyxia, and most of all in the newly-born. The instrument can be used by the nose or mouth.

1. *Introduction of the tube through the nose.—Desault's method.*—A gum elastic catheter, of large size, with a stilette suitably curved, is introduced through the nasal fossa as far as the pharynx. The jaws of the patient are kept open by means of corks, to enable the operator to seize, with his fingers or forceps, the end of the catheter. The stilette is withdrawn, and the end of the catheter is held against the tongue while the catheter is pushed on well into the larynx. When the operation has succeeded, the hand holding the instrument feels that an obstacle has been overcome; the patient has a sudden cough, and there is spasmodic raising of the larynx; air comes out of the open

epiglottis is raised, and the instrument is passed on until it is well in the larynx, and then the disk of sponge closes the laryngeal opening around the tube.

If the tube is in the glottis, the chest is at once dilated by blowing in ; but if in the œsophagus, the abdomen will be inflated first. To ensure success, we are counselled to firmly press the child's lips round the tube with the thumb and forefinger of each hand, while the second and third fingers compress the nostrils and close the nose. First of all, the operator should suck out all mucus from the trachea and bronchi ; then blow in air with the mouth, imitating the equal periods of natural breathing. After each insufflation, the free end of the tube is left open. The insufflations must be made gently—not to rupture the air cells, by the sudden and violent ingress of a quantity of air. Twelve or fifteen insufflations a minute are enough. After each of them the hands are pressed gently on the chest, to give the walls the movement of natural expiration.

It is often not till the expiration of an hour that the artificial respiration re-animates the infant and stimulates the heart. It must therefore be continued gently and patiently. The operation should not be given up until the heart beats 120 to 130 times in a minute.

Figs. 1, 2.—ANATO

Fig. 1.—The œsophagus diverging a
chiefly on the left side of the neck tha
taken.

Under the skin and cellular tissue we
***g*, and the hyoid muscles, *e*, *f*; the exte**
which crosses the sterno-mastoid is scan
the area of the incision. At the level of
cellular tissue between the inner edge of
the hyoid muscles, we find the laryngeal
***b*, and thyroid, *d*, arteries. Thus the**
carried higher than a point from ½ to ¾
hyoid bone.

***Fig.* 2.—Beneath the sterno-mastoid, *g*,**
artery, *j*, and the jugular vein, *i*, contained
These vessels cross the œsophagus, *L*, in a lin
forwards and without inwards. Drawing
forwards, we find the trachea, *G*, which
œsophagus ; lower down is the inferior th
lowest point of the incision must not com
than two or three fingers' breadths, on ac
Above, at the level of the hyoid bone,
lingual, and superior thyroid arteries menti

***Fig.* 3.—*Œsophagotomy.*—*a*, *a*, incision**
the anterior

The operator stands on the patient's left, so as to be able to make the incision with the right hand, while the left hand separates and protects the structures which have to be avoided.

An assistant on the patient's right side, supplied with blunt hooks, draws aside the right edge of the wound, the hyoid muscles, and the trachea.

The operator then with a convex bistoury makes an incision three inches long, parallel to the trachea, and in the groove which separates the sterno-mastoid and thyroid muscles. The incision will pass through the skin, cellular tissue, and cervical fascia ; the cellular tissue in the intermediate groove will be carefully divided on a director; the inner border of the sterno-mastoid muscle will be kept out of the way by the fingers of the left hand, while the assistant gently presses aside the laryngo-tracheal mass.

The trachea must be handled carefully not to interfere with the respiration. Accessions of dyspnœa will cause sudden movements which are dangerous to the patient. The omo-hyoid muscle crosses the wound diagonally ; when it does not interfere with the operation seriously, it is to be moved out of the way upwards, otherwise it must be divided on a director.

At the bottom of the wound and behind is the cellular sheath of the great vessels, which must be pulled away from the œsophagus ; in front the assistant removes the trachea with a blunt hook. The œsophagus then appears at the bottom of the wound in the form of a broad muscular band lying on the cervical vertebræ. The foreign body oftens helps to distinguish the organ by the swelling it causes. The patient may be made to swallow, which will make the muscular band contract and become firmer.

The œsophagus, being clearly defined, the bistoury is used to make a puncture, which will serve to begin an incision at first of small extent, but afterwards enlarged with a probe-pointed bistoury to give exit to the foreign body.

If the operator cannot distinguish the œsophagus in the wound a tube or probang must be passed down to assist in defining it. This step is especially necessary when the foreign body is below the wound, and cannot therefore give any indication of the gullet by expanding it. A bougie is enough to serve as an index of the position of the tube, and to act as a point of resistance for the incision. *Comes'* dart sound may be employed; making the dart puncture the point selected, a passage is procured for a probe-pointed bistoury. But the most convenient instrument is Vacca's. This is a catheter penetrated in part of its length; a channelled stilette is made to protrude from the opening, when a button is turned. The bulging caused by the protrusion of the stilette will guide the operator in making the incision.

The incision made; the foreign body is to be extracted; polypus forceps, tenacula, hooks, etc., will be useful for this purpose. No general rules for extractive manœuvres can be given. The nature and form of the foreign body, the depth at which it lies, will help to indicate what course is to be pursued. After the operation the edges of the wound are brought together by simple dressing. Union by first intention is not to be tried. If the incision in the œsophagus is sufficiently extensive it will be prudent to leave a hollow sound in the canal for some days, to con-

PLATE LVI.

BRONCHOTOMY.

Figs. 1, 2, 3.—*Surgical anatomy of the front of the neck.*

Fig. 1.—*Subcutaneous layer of front of the neck.*—*a*, *a*, lower jaw; *B*, hyoid bone; *C*, thyroid cartilage; *d*, *d*, carotid vessels; *e*, *e*, infra-hyoid muscles; *g*, *g*, external jugular veins; *f*, *f*, anterior jugular veins; *h*, sterno-mastoid muscles.

The larynx and trachea are covered in front by skin and superficial fascia enveloping the platysma. Some anastomosing branches of the anterior jugular vein are found here. The sterno-hyoid and sterno-thyroid muscles, sometimes meeting in the middle line, hide the larynx and trachea under a thin muscular layer; lastly, deeper and at the level of the cricoid cartilage is the thyroid body, whose size and position are variable.

Fig. 2.—Below this superficial layer we find the hyoid bone, *A*, the thyro-hyoid muscles, *C*, *C*, separated in the middle line, and exposing the thyro-hyoid membrane, and the thyroid cartilage, *B*, the crico-thyroid muscles, *d*, the thyroid gland, *E*, and the trachea, *F*. A dotted line, *g*, *g* shows the upper edge of the sternum and clavicles. By the sides of the larynx and trachea are the carotid vessels: *h*, *h*, the common carotid; *i*, superior thyroid artery; *j*, inferior thyroid vessels; *k*, *k*, internal jugular veins; *l*, innominate vein; *m*, inferior thyroid veins; *n*, innominate artery. The thyroid veins when divided in tracheotomy often bleed severely. The incision must not be carried too low, lest the innominate veins be wounded; the finger-tip in the wound will perceive the pulsations of the large arteries. In describing the operation we shall have to insist on the importance of these anatomical data.

Fig. 3.—*Anatomy of the larynx.*—*a*, hyoid bone; *b*, thyro-hyoid membrane; *c*, thyroid cartilage; *d*, crico-thyroid membrane; *e*, *e*, cricoid cartilage; *f*, trachea; *g*, *g*, internal jugular veins; *h*, innominate vein; *i*, *j*, *j*, thyroid veins.

Fig. 4.—*Operation of tracheotomy.*—*a*, *a*, incision in the middle line in front of the trachea; *b*, *b*, tape to keep the canula in the trachea. Under the generic name ***brochotomy*** are included those operations which are intended to obtain an artifi-

(tracheotomy).

Bronchotomy ought to be used in all cases
of a patient is threatened by a mechanical obst
tion.

The obstacle may arise from the presence of
or from disease of the air passages.

1. *Foreign bodies.*—The accidental entrance
stances is the most common case which may call f
Not only can such bodies produce suffocation, b
up ulcerations in the larynx and trachea, perfo
and cause the most alarming accidents; ther
double reason for operation when the body is no
by the cough.

Foreign bodies in the œsophagus, about th
larynx or trachea, may so compress those organ
such a degree of apnœa as to demand immediate

2. *Organic lesions of the air passages.—Tonsill*
Flajani performed tracheotomy for inflammator
of the tonsils. But his example is not to be foll
can usually be controlled by free scarification.
of treatment should be employed before havin
the more dangerous measure.

proposed tracheotomy for cases of œdema of the glottis, it has been successfully practised by a great number of surgeons. And laryngotomy is better than passing a tube through the mouth.

Laryngeal diseases, as chronic inflammation, tuberculosis, or wounds, may produce suffocation by causing contraction of the calibre of that organ, through cicatrisation. In these cases bronchotomy has been successfully employed by numerous surgeons.

Tumours.—Bronchotomy may be called for when asphyxia is threatened by the pressure of tumours in parts adjoining the larynx.

Croup.—Others had successfully used bronchotomy in croup but Bretonneau regularly adopted this mode of treatment, and gave indications demanding its use.

Not only does bronchotomy, by enabling the false membranes to be removed, snatch the patient from imminent death; but prolonging life, the diseased parts have a better chance of regaining a healthy condition.

The greatest probability of success is when tracheotomy is performed on an infant suffocated by croup in the *larynx*. When the false membranes extend into the trachea the operation succeeds in fewer cases, and is almost useless when the disease extends to the bronchi. Nevertheless, the precise seat of croup being difficult to ascertain, we should, in all circumstances when asphyxia is threatened, decide on performance of the operation.

INFRA-HYOID BRONCHOTOMY.

This operation has been proposed by Malgaigne in cases where foreign bodies or grave disease are seated in the larynx.

In this operation (*not yet performed on a living subject!*) we divide the fibrous membrane, *b* (Plate LVI., fig. 3), which extends from the hyoid bone, *a*, to the thyroid cartilage, *c*, and thus descend directly upon the upper orifice of the larynx.

Malgaigne's operation.—A transverse incision two inches long is made directly below the hyoid bone, along its lower edge. The second step is to divide the platysma and the inner half of each of the sterno-hyoid muscles; then directing the point of the bistoury backwards and upwards, the thyro-hyoid membrane and its fibrous extension to the epiglottis are cut through transversely. We thus reach the mucous membrane, which is protruded at each expiration. It is held with forceps and divided with the bistoury or with scissors; the epiglottis then appears, driven into the wound by expiration; it is held out of the way with forceps or a hook, and the whole larynx is exposed to view, so that instruments are easily guided.

THYRO-LARYNGOTOMY.

The superficial position of the thyroid cartilage renders this operation very easy. The thyro-arytenoid muscles and the vocal cords which are attached to its posterior surface, in the lower third of the median line of the cartilage, alone demand the consideration of the surgeon.

Operation.—An incision is made extending from the hyoid bone to the cricoid cartilage; if the isthmus of the thyroid body interferes with reaching the crico-thyroid membrane, it is to be pulled down; the infra-hyoid muscles are separated, and after having determined the exact position of the crico-thyroid artery, the bistoury is passed through the membrane which and the isthmus of the thyroid gland pushed downwards, if in the way of the operator, and the crico-thyroid membrane is thus exposed. If the crico-thyroid artery is large, it is seen crossing the membrane, and must be avoided in opening the larynx. Some surgeons advise that the membrane shall be opened by a longitudinal incision, and enlarged if necessary by a crucial incision. The author makes only a horizontal incision, and of sufficient size to enable the tube to be inserted without inconvenience.

LARYNGO-TRACHEOTOMY.

This operation was performed successfully by Boyer. The incision extends from the lower edge of the thyroid cartilage to the first three rings of the trachea (inclusive). The muscles are separated, the thyroid gland and the crico-thyroid artery pulled upwards, and the bistoury, passed in just below the artery successively divides the crico-thyroid membrane, the cricoid cartilage, and the first rings of the trachea.

The divided cricoid turns forcibly inwards, and it is difficult to separate the edges. The passage of a canula is almost impossible, except through the rings of the trachea.

TRACHEOTOMY.

In some cases, for this operation, trocars of various sizes, straight or curved, have been used; they are passed at once into the trachea. This mode of operation and these instruments are now abandoned, and it is preferred to freely open the trachea in the middle line, in order to easily introduce canulæ, which answer the purpose to be attained better than those used with the trocar.

Anatomy (Plate LII. and explanation).—It is only necessary here to remark that the lower we go the deeper is the trachea, and that it is crossed at the level of the sternum by the innominate artery, and that in the case of croup or impaction of foreign bodies the soft parts may be infiltrated with serum or gas.

The instruments (supposing the case to be one of croup) needed are :—(1). A straight bistoury. (2). Dissecting forceps. (3). Blunt hooks or retractors, with which the assistants are to separate the edges of the wound. (4). Dilating forceps, or a dilator. 5. Single or double canulæ ; a hair probang to clean the canulæ, and sponge probangs to clean the trachea. In extracting foreign bodies long curved forceps are needed, in order to reach a substance impacted above or below the point of the incision.

Operation.—We here insert the description given by Trousseau:—

"The child lies on a table, a rolled pillow under the nape of the neck, to make the front of the neck curve well forward—an important condition; the surgeon (having at least three assistants) cuts quickly through the skin, then more carefully penetrates to the trachea, until the tracheal rings are exposed. The trachea is then sufficiently opened. If possible the venous trunks should be avoided; if they *cannot* be avoided, cut them through without stopping to tie them, as the bleeding will stop directly the tube is placed in the trachea.

"When the trachea has been opened, the branches of a dilating instrument must be passed between its edges; lift the child, and wait for a few moments until breathing has become regular and the bleeding has stopped.

"If, in spite of the opening, the child remains in a state of anastomose across the trachea, in which case they must be cut. Much blood flows, which can usually be stopped by pressure with the tip of the finger by the surgeon on one side or by an assistant on the other side. In the meantime the incision is continued, guiding the knife along the finger nail (deep in the wound), and taking care to sponge often, until the trachea is seen, when it is quickly opened, and the dilator inserted; the bleeding then stops at once.

"I advise, then, that the veins be not tied, because, having now (June 1, 1842) performed the operation 121 times, I have never found the need of doing so. Besides which, the ligature may prove hazardous, partly by inducing phlebitis, which is particularly dangerous in this region, and partly by protracting an operation which is often done under circumstances when it is most important not to lose any time.

"*Accidents during operation.*—One of these is hæmorrhage. We have seen how rare and how very seldom this is serious. But if we are obliged to cut several thyroid veins, and the blood pours out in a stream, the trachea must be taken between the ulnar edge of the first finger and the radial edge of the middle finger (passed deeply into the wound till the spine is touched), then cut the trachea open quickly from below upwards, and at the same instant pass in the dilator, and the bleeding will stop. I do not speak of hæmorrhage from the thyroid artery or the innominate; it is clear that such vessels must be tied at once to save the patient's life. I don't know that such an accident has ever happened; but I have many times felt under my finger the beating of the innominate artery, which I should certainly have cut if I had moved my bistoury carelessly in the lower end of the wound.

"I have many times seen asphyxia arise and breathing stop during the operation; the patient was in a state of apparent death. I finished the incision as quickly as possible, passed the canula in; then, the patient being placed on his side (if blood has run down the trachea, or on his back if not), I made alternate pressure on the stomach and chest, which initiated respiratory movements, and all my patients have returned to life.

"Syncope is a more common accident, appearing usually just after the operation, at the moment when, the breathing becoming easy, cerebral congestion ceases suddenly. I once saw it last nearly an hour ; still it was not fatal. I merely throw cold water on the face, and some drops into the trachea, mopping it out briskly ; and I keep the patient lying flat.

"As to the passage of blood into the trachea, much has been said about it, but I have never seen serious results from it, provided that the dilator is used at once, and the lips of the tracheal wound are kept open ; or that, by some means or other, a good sized canula is promptly put in ; for if after having made the opening the surgeon fumbles, and cannot introduce the canula, a lot of blood passes into the trachea at every inspiration ; and the air not being able to enter asphyxia may be the immediate result ; the hæmorrhage is also kept up by the continued obstruction to the breathing.

"If, on the other hand, the dilator keeps the tracheal wound open, the air passes in easily, and blows out the small quantity of blood which has entered, and the return of normal breathing checking the hæmorrhage, there is no longer any influx of blood ;

"If the child is strong, and has energetically expelled the false membranes from the air passages, and if after the operation the breathing is easy, then, before introducing the canula, fifteen or twenty drops of a solution of nitrate of silver (five grains to the ounce) are to be dropped into the trachea in two portions; or if there is reason to suppose that the larynx alone has been invaded by the diphtheria, then a probang soaked in a strong solution of nitrate of silver (eighty grains to the ounce) is passed along the trachea.

"The canula is then introduced; but this should take place immediately in the case of children operated on in the last stage of croup. And a few drops of cold water in the trachea, followed by sponging out, will be the only measure practicable.

"*Canulæ.*—The canula should be of such length that at the moment it is introduced into the trachea, it passes along the canal to a distance of nearly an inch. This is indispensable, for the day after the operation the skin and adjacent tissues will be swollen to such a degree that the canula will not penetrate more than ⅓ of an inch. If the canula is not long enough, it starts from the trachea in the attacks of cough, and the child may be suffocated.

"If it is essential to have a canula of good length, it is still more important to have it large enough. For infants from six months to two years old the tracheal opening of the canula should be ⅙ inch in diameter; for those of two to four years old ¼ inch; for youths ⅓ inch; for people of great stature ½ inch.

"The canula must be withdrawn whenever the respiration is embarrassed, if there is reason to think that the obstruction is in the artificial air passage. In general it is enough to change the canula twice in twenty-four hours. The expulsion of false membranes, which would obstruct the passage, and abundance of mucus would demand more frequent attention.

"When, instead of the single canula, a double one is used, the inner one must be withdrawn every three hours and replaced at once; this is done without the patient's perceiving it, and renders the blocking of the tubes almost impossible.

"During the first two or three days, when the canula is withdrawn, the tracheal wound closes directly, and to such an extent as to cause symptoms of asphyxia; therefore another canula or a dilator must be passed in at once, and the dilator is very useful when the canulæ are changed, preventing a great deal of suffering on the patient's part.

"The moment when the canula is removed, or the wound is held open by means of the dilator, is that which should be chosen for touching the mucous membrane with solutions, or sponging out the trachea with a probang.

"At the end of two or three days the wound in the trachea remains open for some minutes after the removal of the tube, which can then be easily replaced without the aid of the dilator. On about the eighth day the tracheal wound will keep open for nearly an hour; later on the patency will last through a whole day, or even longer.

"When, about four or five days after the operation, the patient seems to be going on well, the tube should be allowed to remain out for a short time, that the air going into the larynx may displace the mucous and false membranes, and clear its way through the organ. The permeability of this air passage may be short time usually the trachea closes completely; the wound in the other soft parts also soon closes, and the cicatrix is not important.

"On one occasion I was able to remove the canula finally at the end of four days; sometimes it has been from the sixth to the eighth, *usually* from the sixth to the thirteenth; once on the forty-second day; once on the fifty-third. When no accident arises, then the larynx clears itself in from four to thirteen days. I have never yet seen an "aerial fistula" after tracheotomy.

"*Treatment after operation.*—When a child has reached the extreme stage of croup, some physicians consider that there is only one treatment indicated—do tracheotomy and put in a canula. For my part, tracheotomy appears to be the means to ward off asphyxia, which will kill the patient, and afterwards to convey to the mucous membrane of the trachea and bronchi applications capable of stopping the reproduction or extension of false membranes. I know that many of my *confrères* have been successful while they have been satisfied with frequently changing the canulæ, and sponging from time to time, but I have preferred to keep up local medication. I tracheotomised in succession twenty children, and applied no lotions to the mucous membranes, and the results were so unfavourable that I returned to the topical medication which had been so beneficial previously in my hands.

"The topical treatment which I have adopted is the following it is that of Bretonneau :—

"As has been said before, if the child is strong, if he has forcibly expelled the false membranes from the air passages, and if after the operation the breathing is good, then, before introducing the canula, at two or three times the following solution is dropped into the trachea : fifteen or twenty drops of a solution of nitrate of silver, five grains to the ounce. This application is to be made four times the first day, three times the second and third day, once or twice the third day, and then it is given up. At the same time a probang is used in the trachea, consisting of a very small sponge fixed to the end of a very flexible whalebone stem, and soaked in a strong solution (one part in five of water) of nitrate of silver.

"This last manœuvre is enough, if there is reason to believe that the larynx alone is affected. Cauterisation in this manner is to be repeated as often and for the same length of time as the probang application above mentioned. The use of the probang alone and the dropping in of water are important additions to the above treatment.

"If the cough is loose and the expectoration free there will be no need of the water. On the other hand, eight or ten drops of lukewarm water dropped in once or twice every hour will mix with the mucus, soften it, and assist its ejection.

"Water should always be injected or dropped into the canula after using caustic solution to break up the coagulated mucous and help its expulsion. The use of water should be many times in an hour; and if the respirations are rapid and "serratic," that is, if they resemble the sound of a saw cutting stone, every use of the probang should be followed by dropping in water.

"The canula and trachea must be sponged whenever respiration appears embarrassed; and the operation will be more efficacious if preceded by the use of water. If a sound of a clackvalve is heard in the trachea, or a peculiar whistling gives reason for think-like to have been able to compare the cases whose after treatment was according to my method with those treated more simply. But we know that there are now living in Paris nearly fifteen children tracheotomised in the last stage of croup, and in whom our method was not followed."

PLATE LVII.

EXTIRPATION OF THE BREAST.—EMPYEMA.

Fig. 1.—*Amputation of the breast.*—*a, b, c.* first curved incision made at the base of a cancerous mamma : *c', b', a*, second incision, which with the first includes the breast in an elliptic flap.

Fig. 2.—*Dressing after operation.*—*a, a', a, a'*, etc., adhesive strips keeping the edges of the wound together. A strip of lint, *b*, is fastened in the angle of the wound for drainage.

Fig. 3.—*Anatomy of the chest walls and intercostal arteries.*—These arteries divide into two branches about the posterior third of the rib. The upper branch (which is the larger) runs in the groove on the under side of the rib above, and leaves it about the anterior third. The inferior branch runs along the upper edge of the rib below.

Fig. 4.—*Operation for empyema.*—*Sédillot's operation.*

EXTIRPATION OF THE BREAST.

The scirrhous or encephaloid tumours, which are developed in the breast, most commonly call for this operation. Many surgeons have objected to the operation on account of the tendency to recurrence of the tumour.

In the meantime, all tumours of the breast not being liable to recurrence, and numerous malignant tumours never recurring, most practitioners prefer to operate if the patient presents conditions favourable to success : these are mobility of the tumour, with well marked outline, and the age, strength, and health of the patient. Large size of tumours, adherence to the ribs and processes in the axilla, affections of the axillary and cervical glands, pale yellow colour of the skin, characteristic of the cancerous cachexia, the presence of tumours in other parts of the body, revealing general affection of the system—all these are contra-indications. Yet adhesion to the ribs, without further unfavourable conditions (such as those above-mentioned), is not enough to forbid an operation. Operation is not likely to lead to permanent cure unless there is good reason to suppose that the disease is purely local.

OPERATIONS.

Compression, condemned by C. Bell, but supported by Récamier, is now rejected by surgeons as useless in the case of cancerous tumours ; its successes were probably attributable to errors in diagnosis.

Ordinary method.—The instruments needed are, straight and curved bistouries, dissecting forceps, hooks, artery forceps, waxed thread, rugines, resection saws. Hot irons may be useful if the disease has attacked the ribs.

The patient lies on the table, the body turned to the side operator first dissects from below upwards, then from above downwards, taking care to remove a layer of sound tissue. Commencing the dissection at the lower part of the tumour, we are not troubled by the blood which would run over the parts to be cut if the operation began above. Yet some operators prefer dissecting downwards, not to catch the bistoury under the Pectoralis. When the tumour is very large, it is to be raised by strokes of the knife made alternately above and below, so as to gradually isolate the mass from the periphery towards the centre.

When the tumour has been removed, the arteries tied, the wound sponged, we proceed to examine the subjacent tissues. All the parts which appear changed should be taken away, either with the knife or with the curved scissors. Suspected glands must be exposed to view by lengthening the incision, and as it might be dangerous to dissect in the axillary region, and neighbourhood of large vessels, it is more prudent to unseat them and twist them out with the fingers. It is generally at the level of the thoracic vessels—below, on the Serratus Magnus, and above, under the Pectoralis Minor—that affected glands are found. (The anatomy of the axilla is given at page 22, Plate IX.)

The operation ended, it is necessary to dress the wound at once; some surgeons wait some hours before closing it, in order to watch the arterioles which could not be tied, and to be able to close the wound without fearing ulterior hæmorrhage. The edges are then brought together by twisted sutures (page 7, Plate II., fig. 6). If the wound is of small extent, and the edges are capable of easy extension, they may be brought together by means of very long adhesive strips, ⅓ an inch, crossing at right angles to the line of the wound (Plate LVII., fig. 2). In cases, on the other hand, where the approximation of the edges is difficult, the edges must be dissected up to a movable distance to separate them from the subjacent parts. The cicatrix of the wound will be watched carefully, and if any buds of malignant growth appear they must be at once destroyed with the knife, the hot iron, or some kind of caustic.

EMPYEMA (Figs. 3, 4).

Pus, serum, or blood contained in the thoracic cavity may require removal. In the normal state the lungs fill the chest, but when there is a collection of fluid in the cavity of the pleura, it presses upon the lungs from without inwards. The effusion may be so great as to compress the lung, and thus to obstruct respiration. We have already remarked that blood, pus, serum, and even gas may collect in the pleura, and necessitate an operation; and the nature of the effused fluid, its quantity, its situation, the different complications to which it gives rise, constitute so many indications for the operation, either at any spot which the operator chooses to select, or at some particular spot where the operation is alone feasible.

Effusion of blood.—If the effusion of blood is the result of an injury, the surgeon should not be in a hurry to evacuate the fluid, the presence of which tends to close the ruptured vessel, and to arrest the hæmorrhage. Care must be taken to place the patient in a proper position, to close the wound which has threatened, notwithstanding the absence of inflammatory symptoms, that an operation is likely to be successful. Surgical interference is uncalled for at the beginning of pleurisy, and when the inflammation is still in its acute stage, unless a fatal issue from compression is feared. Nor should an operation be ventured upon in those chronic pleurisies where the effusion continues long after the attack, and where the lung, driven back upon itself, is no longer able to exert its elasticity, unless at least a month has passed away and the health of the patient does not progress.

Effusion of gas.—Air or gas effused in the pleura is so quickly reabsorbed when the cause of the effusion is slight, that it is quite unnecessary to resort to an operation.

OPERATIONS.

According to Galen the Greeks perforated the chest with a red-hot iron; a method which was adopted by Paulus Œgineta. The operation for empyema—sometimes practised in the form of cauterisation, at other times by an incision into the intercostal spaces, or trephining the ribs themselves—has been attended at various times by very different results. After having been more than once abandoned and again revived, it was finally established as a legitimate operation by Dionis, Ledran, Foubert, and Morand.

Numerous facts furnished by the practice of contemporary surgeons show that they are successful in about five out of ten operations; a success which is quite sufficient to justify the practice in those cases in which this operation is imperatively called for.

Is it necessary to draw off the whole of the fluid at once, by a free and rapid evacuation, or is it better to remove the fluid slowly and gradually by means of repeated tappings by the aspirator? There is no occasion to enter upon the discussions and the differences of opinion to which this question for a long time gave rise. Modern surgeons, and chiefly M. Reybard, whose operation will be presently described in detail, have sufficiently demonstrated the advantages of the latter plan.

1. *Where the spot to be selected for the operation is optional.*—As a rule the opening is best made at some dependent spot in the lower part of the chest, and where there are no adhesions. The ninth or tenth intercostal space should be preferred, as lower down the diaphragm might be wounded. In thin subjects it is always easy to mark with precision the place where the opening is to be made, as the ribs can be felt and counted. If the obesity of the patient does not admit of the intercostal space being exactly determined, the puncture can be made about five fingers' breadth below the inferior angle of the scapula, or about the breadth of three fingers above the cartilaginous border of the ribs. The puncture should be made more behind than in front, close to the union of the posterior third with the two anterior thirds of the circumference of the thorax.

2. *When the place chosen is not optional.*—This is indicated by the seat of the effusion. Generally the adhesion can be best avoided by performing the operation about the centre of the effusion.

in the wound the middle of a piece of lint. in the cul-de-sac of which some pellets of charpie should be inserted, while some cotton wool and a thick compress and a bandage nicely adjusted to the body complete the dressings.

Two hours afterwards the pus may be again discharged, and the operation repeated at the same intervals. A little air often penetrates the chest when the dressings are removed; but this accident need not create any uneasiness, provided that it does not again take place during their re-application. Where, either from want of care or from some other cause, the collection of pus discharges itself and is replaced by air, the air may be removed with M. Stanski's air-pump, or some other aspirator, and the chest injected with an antiseptic fluid.

M. Velpeau's operation.—In the case of sanguineous effusion, or when the fluid penetrates beneath the intercostal integuments, M. Valpeau boldly plunges in a bistoury as far as the pleural cavity, enlarging the wound as he withdraws the instrument. When the diagnosis is not doubtful, this proceeding has this advantage, that a large opening gives free vent to the effusion, whilst a very small one may admit of the entrance of air without allowing the complete evacuation of the pleural cavity.

M. Vidal de Cassis' operation.—M. Vidal proposes to perform the operation several times. In the first operation he advises an incision to be first made through the skin, the subjacent cellular tissue, and the muscles, including the external intercostal muscle. As soon as the internal intercostal muscle is exposed, the operation is stopped, and the wound is filled with charpie, with the view of setting up suppuration. A piece of caustic potash, as large as that employed in making a pea-issue, is then placed in the wound. This gives rise to an eschar of the size of a sixpence, which is gradually thrown off; while during its separation there is established around the borders of the mortified disc first an oozing, then a discharge which takes place so gradually as to give the lungs time to dilate to the walls of the chest, and the latter to close upon the substance of the lungs. The inspiration of air into the lung takes place gradually, and but a very minute quantity can enter the pleural cavity by the external opening.

M. Reybard's operation.—This operation, which is both simple and ingenious, permits of the continual discharge of the effused fluid without allowing the air to enter the pleural cavity. M. Reybard perforates a rib with a trocar, and he allows a canula, or the barrel of a quill-pen, to remain in the wound. The free extremity of the canula consists of catgut, or of a tube made of gold-beater's skin, which can be made soft, and the advantage of which is that the fluid in the pleura easily escapes externally at each inspiration, while the air is prevented from entering the chest by the soft walls of the skin tube collapsing one against the other and closing up the end of the canula. M. Trousseau plunges the free extremity of this instrument into a vessel full of water, a proceeding which makes the introduction of air an impossibility.

M. Stanski's operation.—According to M. Stanski, the most essential indication is to fill up and to obliterate the sac, to prevent the entrance of air into the thorax, and to exhaust the symptoms, etc., will guide the operator as to whether he should have recourse to a slow or to a quick method of emptying the chest.

PARACENTESIS OF THE PERICARDIUM.

A dangerous operation; which is not very often necessary. When, however, the operation is deemed to be justifiable, the pericardium may be opened in three situations: (1) between the fifth and sixth intercostal space; (2) through the sternum; and (3) through the space which lies between the xiphoid cartilage and the cartilage of the seventh rib.

1. *Desault's operation.*—This surgeon made an incision between the sixth and seventh left ribs, on a level with the apex of the heart. The muscular structures were divided layer by layer, until his finger, plunged into the wound, felt a pouch full of fluid. This Desault opened; but the autopsy made four days afterwards showed that he had only opened a cyst, beneath which he found the pericardium.

2. *Skiederup's operation.*—This consists in trepanning the sternum in a line with the mediastinum. By this means a triangular space is reached, the base of which is formed by the diaphragm, and whose summit is on a level with the fifth rib. There is not much resistance met with in trepanning the bone until the internal periosteum is reached. This is very hard, and therefore the surgeon should proceed carefully for fear of wounding the pleura. The opening being effected, the patient should be made to lean forward, so that the pericardium may come within reach of the finger of the operator. A straight bistoury guided by the finger will serve to open the sac.

3. *Larrey's operation.*—In passing through, from below upwards, the space which separates the left border of the xiphoid cartilage from the cartilage of the last true rib, we come upon the most depending part of the pericardium. By this method, which is preferable to those described above, it is easy to avoid the pleura, the peritoneum, the diaphragm, and the internal mammary artery.

LESIONS OF THE INTERCOSTAL ARTERIES.

The only wounds that can do much injury to the intercostal arteries are those which are seated in the posterior third of the chest. When the wounded vessel is visible it must be tied. The operations which, independently of the ligature, have been undertaken with the view of arresting the hæmorrhage are even more numerous than the recorded observations of these wounds. Before operating it is necessary to discover the source of the hæmorrhage. It has been proposed to introduce into the wound a card bent into the form of a gutter.

If the blood escapes beneath the card, it proceeds from some injury to the lung; if above the card, an intercostal artery is the source of the hæmorrhage.

In cases where the wound of the artery is easily recognized, the finger, covered with a fine compress, like the finger of a glove, should be inserted into the wound. Then the cul-de-sac of this compress is to be filled with charpie so as to form

PLATE LVIII.

OPERATIONS WHICH ARE PERFORMED ON THE ABDOMEN.

PARACENTESIS OF THE ABDOMEN.—ANATOMY.

Figs. 1 & 2).—It is generally over the middle of a line (*a*, *c*, fig. 1), extending from the umbilicus to the left anterior superior spinous process of the ilium, that French surgeons plunge their trocar in the operation of paracentesis. By this means it is easy to avoid the fleshy parts of the abdominal wall, or any injury to the deep epigastric artery (*b*, fig. 2) which courses beneath the rectus muscle.

In England this operation is performed in the course of the linea alba (*a*, *b*, fig. 1).

The object of abdominal paracentesis is the evacuating of a collection of fluid in the peritoneum. Ascites is the disease in which it is usually practised; but this affection may be complicated (1) with pregnancy; (2) with an ovarian cyst; (3) by partitions constituting encysted dropsy; (4) with a congenital hydrocele. These various complications will indicate the place where the operation should be performed. In the case of pregnancy care must be taken to avoid the uterus. It is under this latter circumstance that Scarpa proposed to make the puncture in the left hypochondrium, a little below the third false rib. The umbilicus was selected by Ollivier d'Angers. M. Velpeau thought the puncture might be made without any risk in any part of the left flank. With regard to the best method to be adopted, the surgeon should likewise take into consideration the stage of pregnancy, the situation of the uterus, etc. In the case of congenital hydrocele, Morand and Ledran tapped the hydrocele. In encysted dropsies, and in doubtful cases, fluctuation and the swelling formed by the fluid will indicate the spot where the operation should be performed.

The ordinary operation.—Puncture with the trocar.—The instruments required for this operation consist of a trocar, a bandage for the body, and a bandage, by means of which pressure is made upon the abdomen while the fluid is being drawn off.

The patient lies upon the edge of the bed, and the operator finds out, by percussion, the level and the extent of the effusion in order that he may not plunge the trocar into that part of the abdominal wall which lies over the coils of intestine. An incision ⅓ of an inch long is made through the integument to assist the passage of the trocar. An assistant makes with both hands methodical pressure on the opposite parts to that operated upon.

Taking, then, a good hold of the handle of the trocar, with his forefinger so placed on it as to limit the length of the instrument which is to enter the abdomen, the surgeon, with one thrust, plunges it into the peritoneal cavity. The canula is then held in its place with one hand, while the trocar is withdrawn with the other. Flocculi floating in the serous effusion, or even a coil of intestine, may close the internal aperture of the canula, and thus obstruct the

the canula should be left in the wound, or it should be replaced by a piece of wax or gum-elastic bougie. The wound may also be raised into a fold of skin, on which pressure is maintained.

M. Baudens' operation.—It sometimes happens that the effusion, having distended and ulcerated the skin, makes for itself an opening on a level with the umbilicus. This accidental and fistulous opening allows the fluid to escape continuously. With the view of imitating this accident, M. Baudens designed a canula which, being allowed to remain in the side, and having a self-closing action, permits of the patient drawing off the fluid as fast as it collects. The umbilicus is the place selected by M. Baudens for the application of his canula. This method, which necessitates the use of a special instrument, is an ingenious modification of that adopted by M. Fleury, but is not unaccompanied by danger.

We shall not here dwell upon the different plans, injections, foreign bodies, etc., that have been proposed for the radical cure of ascites. They are all attended with danger, and it is better to resort to the operation of paracentesis as often as the disease requires it.

GASTROTOMY.

Gastrotomy signifies cutting into the belly, but the term is generally applied to the operation of cutting into the stomach.

This operation is justifiable when a foreign body is present in the stomach, but only when the foreign body, not being able to pass through the pylorus, gives rise to some serious mischief, or threatens to make its way out externally. The operation in these cases has been particularly successful. An incision should be made over the tumour or over the abscess that has been formed. But if there are no external signs of the presence of a foreign body, an incision of three inches in length may be made in the epigastric region, over the middle line. The peritoneum should be cautiously divided, the transverse colon drawn to one side, and the anterior surface of the stomach, being drawn out and exposed, should be opened in such a situation that there can be no risk of wounding the coronary arteries.

It is quite unnecessary to insist upon the dangers inseparable from so serious an operation. Before it is determined upon surgeons would do well to make a trial of the lithotrite instrument, which may be easily passed down the œsophagus.

Sédillot's operation.—This surgeon makes crucial incisions three inches in length, the vertical arm of which is on the left side of the middle line of the body, two fingers' breadth from the costal cartilage, and commencing immediately below the level of the ensiform cartilage. The muscular fibres are cut through by these incisions. On opening the peritoneum, the border of the left lobe of the liver is sought for, and the stomach, which lies below it, can be seized and drawn forward by means of the thumb and finger.

Mr. Bryant, in two operations, made the incision from the linea semilunaris, near the xiphoid cartilage, obliquely downwards and outwards, parallel with the line of the ribs.

GASTROSTOMY.

This term, which signifies a stomach mouth, is applied to so as not to exceed the area of adhesion, should be cautiously made, when, if the diagnosis is correct, immediate exit will be given to the pus. When the diagnosis is doubtful, and the existence of adhesions uncertain, it is advisable to employ the aspirator.

Graves's operation.—The tissues are divided layer by layer as far as the peritoneum. The wound is then filled with charpie, and the resulting inflammation gives rise to adhesions, and lays open the abscess.

M. Begin's method.—The tissues are divided as far as the peritoneum, in the same manner as in Graves's operation, and the wound dressed. But on the third day, when adhesions have been established, the abscess is opened with a bistoury.

M. Récamier's operation.—M. Récamier reaches the peritoneum by repeatedly cauterising the parts with caustic potash. The sloughing sets up the adhesive inflammation, and the tumour can be opened with the bistoury or trocar. The walls of an abscess in a parenchymatous organ like the liver cannot become approximated, and a cavity remains behind in which air may collect. It has therefore been proposed to substitute for the pus an injection of some emollient fluid.

The possibility of opening *the gall-bladder*, if necessary, in the same manner as abscesses of the liver may be easily conceived; but the danger of an incorrect diagnosis will make surgeons hesitate before performing such an operation. *Hydatid cysts* may be opened by simple puncture, in like manner, or they may be evacuated by the aspirator.

OVARIAN CYSTS.

Ovarian cysts vary much in size, in form, in consistence, and in the nature of their contents. Some—the *dermoid* class—consist of a mass of fatty matter, in the midst of which are to be found teeth, hair, fragments of bone, etc.

Serous cysts contain fluid, which varies much in consistence. Sometimes they form one large sac completely filling the abdomen, and sometimes they are composed of a variable number of cysts full of fluid, and without any communication between them. The relations of these kind of tumours to other organs are equally variable. At one time they contract adhesion with the large omentum and other parts of the peritoneum, while at another time the tumour is isolated and pedunculated.

Operations.—Tapping.—Tapping is only applicable to cases of dropsical cysts, and is, moreover, merely palliative. It may be performed either at the most prominent part of the tumour or *per vaginam*. Tapping the abdomen is preferable to puncturing the vagina, as there is less risk of peritonitis. To obtain a radical cure it has been proposed to conjoin with the tapping compression, and the use of irritant injections. But experience has not yet shown that there is anything to be gained by this plan, and it is best to confine the operation to simple tapping, with the view of guarding the patient as much as possible from any accidents that may arise.

Incision, recommended by Ledran, is chiefly indicated when the cysts are multilocular, and contain fluid of some consist-to facilitate an incision being made through it as large as that through the integuments. The tumour can then be explored with the view of seeing whether it has contracted any adhesions. If these are slight they may be divided or torn asunder, so that the base of the tumour may be more easily examined. But when they are both strong and numerous, it is better to let them alone, and to merely empty the cyst.

When the pedicle is fully exposed it should be surrounded by a strong ligature. If it be large it should be transfixed with a needle armed with a double thread, and in this way several ligatures can be easily applied. The tumour may then be cut off within ¾ of an inch of the ligatures. When the operation is over the external wound should be closed with the interrupted suture. In some cases an incision extending from the umbilicus to the pubis is not long enough; and it may be necessary to make an incision from the xiphoid cartilage to the symphysis pubis.

There are two other methods of dealing with the pedicle: the clamp and actual cautery.

There are several varieties of clamps in use, the object of all of them being to hold the pedicle firmly, so that no hæmorrhage can take place from the divided vessels, and to retain it external to the abdominal walls.

In using the cautery the pedicle is first clamped, and the tumour cut away about an inch from the clamp; an iron, heated only to black heat, is then applied until the mass is cut off on a level with the clamp. With this method of treating the pedicle there is great danger of fatal secondary hæmorrhage.

WOUNDS OF THE ABDOMEN.

Simple penetrating wounds.

When these wounds exceed an inch or so in length they are almost invariably followed by a hernia of the intestines, or of the great omentum. If the protruding parts are not injured, it will be sufficient to wash them with a little tepid water and to return them. It is sometimes necessary to unravel them before their reduction can be effected. The edges of the abdominal wound may be then accurately brought together, either with the twisted or the interrupted silver wire suture, and a bandage applied round the body.

Wounds attended with strangulation of the viscera.

The protruding parts may be strangulated by the wound, the result of which may be so serious as to call for the prompt assistance of the surgeon. The nature of the parts implicated and the severity of the injuries inflicted will indicate what course should be pursued.

STRANGULATION OF THE GREAT OMENTUM.

SIMPLE STRANGULATION.

The exposed portion of omentum should be unfolded in case it should enclose a small portion of bowel. When only the omentum is engaged in the wound, and when the patient feels no dragging pain in turning round, it is better not to disturb so as to relax the abdominal muscles, the operator presses down the hernia with his left hand, while with the right he introduces a hernia director into the upper part of the wound. The director is then passed beneath the peritoneum, and guides the blade of the hernia knife in the division of the stricture. The operator should take care that the protruding bowel does not overlap the groove of the director, and that the knife does not wound the non-protruding portion of bowel. The left index finger may serve as a guide to the knife instead of a director.

When the director cannot be introduced, the integument should be divided layer by layer as far as the peritoneum. The surgeon, pressing the bowel down with his left hand, passes the finger of the same hand up to the superior angle of the wound, and by careful and repeated incisions reaches the peritoneum, which is then divided with the help of a director.

WOUNDS OF THE INTESTINES.

(See Plate LIX.)

If the wounded bowel remain within the abdominal cavity, it will be only necessary to prevent the occurrence of inflammation by antiphlogistic measures. But when the abdominal wound is large and permits of the coil of intestine being easily drawn out, there is nothing to prevent a search being made for the wound in the bowel, which, if more than ¼ of an inch in length, may be closed with a suture.

Hereafter a description will be given of the operations by means of which an artificial anus may be established. At present it will suffice to mention those measures which are usually adopted to obtain an immediate cure by bringing together the edges of the wound, without interfering with the intestinal tube.

These measures will vary according as the wounds are longitudinal or transverse.

1. *Longitudinal wounds.*

Palfyn's method.—This consists in fastening the lips of the intestinal wound to the peritoneal surface of the abdominal wound. For this purpose a silk thread passed through the edges of the wound keeps them in apposition, while the ends of the thread fastened outside support the bowel against the external wound. This plan, though easily carried out, may lead to the formation of an artificial anus.

Ledran's operation.—More complicated than the preceding, it involves the same principle. Several pieces of thread, about ⅛ of an inch apart, are passed in the same manner as in Palfyn's operation. The ends of the thread are then united, and twisted in such a manner as to ensure the approximation of the edges of the wound, the contraction of the intestinal wall, and the ultimate closure of the wound. The bundle formed by the ends of the threads is fixed outside the abdomen.

Operation of M. Reybard (fig. 2, Plate LIX.).—This operation has also for its object the adhesion of the visceral to the parietal peritoneum. A small longitudinal piece of wood, rounded at its angles, is taken, and a thread passed through two holes made in its centre about ⅛ of an inch bowel; *c*, wooden plate: *d*, coil of thread; *d, d*, external knot of the thread which passes through the abdominal wall, *a, a*.

A. Cooper's operation.—When the intestinal lesion is very slight, it may be seized with a pair of forceps, and a ligature applied to it as if it were a blood vessel.

M. Jobert's method.—The edges of the wound are perforated by several pieces of thread, then reversed in such a manner that by tying them the serous surfaces are kept in apposition.

M. Moreau Boutard's operation.—The mucous membrane of the bowel being everted is excised, and interrupted sutures are applied so as to keep in contact the cut surfaces. One end of each thread is cut near the knot, while the other end should be passed through the abdominal wall in order to ensure the immediate union of the edges of the wound and their adhesion to the wall of the abdomen.

The continued suture, described at page 7, is applicable to wounds of the intestine. The thread serves the purpose of fixing the bowel to the external wound, and at the end of five or six days it can be gently withdrawn.

The operation of M. Reybard.—This is a modification of the continued suture. A sewing needle is used, with a double thread, to the free loop of which is fixed a small plug of lint. The operation is commenced by piercing the parts from within outwards near the angle of the wound. The small plug fixes one end of the thread, and afterwards serves the purpose of drawing the thread along with it in the motions. When the continued suture has been applied the whole length of the wound, the doubled thread is separated, the free ends of the threads are tied, and are then cut close to the knot. The bowel is then returned and the thread cuts its way through the parts to which it is applied, and falls into the bowel, where it is expelled with the stools.

M. Gély's operation.—*The quilted suture* (Pl. LIX, fig. 1). In order to understand this operation the reader should refer to the description of the above plate. A waxed thread is armed at each end with an ordinary needle. One of them is thrust into the bowel parallel to the wound outside and behind one of its angles, and about ⅛ of an inch from it. The other needle is applied in the same manner to the opposite edge of the wound. The threads are then crossed; the needle on the left side passing over to the right, and *vice versâ*. With each thread another stitch is made exactly like the first, taking care to enter each needle at the point from which the other escapes. This manœuvre is afterwards repeated as many times as the extent of the wound renders necessary. That being done, each stitch should be properly tightened before the threads are tied. This may be done by seizing with a pair of dissecting forceps each transverse stitch and even each of the two threads which compose it, making slight traction, and at the same time pressing down the edges of the wound. There is nothing to prevent their being so exactly adjusted that it is impossible to perceive externally any trace of the threads by means of which the union has been accomplished. When the operation is over, it only remains to tie the two threads, and to cut them close to the knot. The needles used should be a little larger than the thread, so that the latter may easily follow the

—Duverger made use of a portion of a bullock's trachea, furnished with pieces of thread disposed at equal distances, each end of which was provided with a curved needle. The trachea was introduced into the two ends of the bowel, and the needles, passing through the intestinal tube from within outwards, ensured the edges of the divided bowel being fixed and approximated over the trachea, while the fastening of the threads preserved the union.

M. Jobert's operation.—When the omentum gets in front of the wounded bowel a fold of it may, as M. Jobert recommends, be interposed between the approximated edges of the bowel and united by a few sutures applied in the manner adopted by Ledran.

Union of the serous surfaces.—Adhesion between serous membranes is readily affected provided the surfaces are kept sufficiently long in contact. Mucous membranes, on the other hand, unite with more difficulty, and the adhesion of mucous and serous membranes cannot be directly accomplished. These facts, which are demonstrated by Bichat and Richerand, led to further researches, and gave origin to the following operations.

M. Jobert's operation (fig. 3).—The two ends of the bowel are separated from the mesentery for the space of ½ an inch in order to facilitate the invagination of the upper within the lower portion of the bowel. The hæmorrhage resulting from the cut mesentery, if slight, need not be interfered with, and at all events a temporary ligature will be sufficient to arrest it. The surgeon then seizes with his left hand the upper portion of the wounded bowel, while with his right hand he passes from within outwards a needle (bearing a thread of sufficient length) through the wall of the intestine about ¼ of an inch from the wound. The thread thus passed through the upper portion of the bowel is held by an assistant. A second thread is passed in the same manner into the upper portion of the bowel, at a point exactly opposite the first.

The surgeon then turns in the border or edge of the lower portion of the bowel, the result of which is to turn inwards the serous surface. Each of the two ends of the threads held by the assistant is passed through a needle which the operator using his finger as a guide, introduces into the bowel in such a manner as to perforate from within outwards the double or inverted edge of the lower portion. The other end of the same thread is passed through the gut in the same manner, about ⅛ of an inch from the first end (fig. 3 *a*).

The same operation is gone through with the free extremities of the second thread, *b*, and then all that is necessary to secure the invagination of the bowel is to make slight and methodical traction upon the threads. The latter drag the upper portion of the bowel within the lower one, and the invagination being completed, the threads may be fastened off, or a few sutures may be applied. Finally the bowel is returned into the abdominal cavity, and the threads, brought together in the lower angle of the wound, are kept externally in position by means of a small piece of diachylon.

M. Lembert's operation (fig. 4 & 4 *bis;* see description of Pl. LIX).—This operation allows of the serous surfaces being posed and kept in position between the central collar and the two others.

The two ends of the bowel are separated from the mesentery to the extent of ½ an inch. The two narrow collars, the diameter of which is the largest, *b*, *b*, are separately introduced within each end of the bowel, the free border of which is turned over the collar, *b*, *b*. Whilst one of the collars is thus covered all round by the borders of the bowel, the collar, *a*, is inserted, which keeps the bowel turned inwards, and by its pressure prevents the border of the intestine slipping out of place. The collar, *a*, which is only introduced in its half, is then engaged in the other collar, *b*, where it also keeps the bowel inverted.

In order to fix this apparatus and keep the collars in position, an intestinal suture must be applied. The surgeon above mentioned uses a needle and silk thread. He passes the needle above the collars, and brings it out below them, *f*, having passed it beneath the central collar, *a*. In the next place the needle re-enters its point of exit, *f*, is passed between the bowel and the external collars, *f*, and brought out at *g*. Fig. 6 represents the course of the thread, *d*, *d*, *d'*, *d'*, *f*, *f'*, *g*. The two ends are then tied, cut off short, and the bowel returned. This proceeding leads to the mortification and separation of the two inverted edges, the serous surfaces of which adhere between the outside collars. The latter are set free within the bowel and are passed *per anum*. The central collar may consist of a spring of elastic steel, which can be taken hold of with a pair of forceps, and easily introduced within the silver collars.

M. Amussat's operation (fig. 5).—M. Amussat introduced into the bowel a cork, *a*, *a*, enlarged at each end, and having a hole through its centre. He then invaginated the two ends of the bowel, and tied them over the cork with the thread, *b*, *b*. The foreign body sets up inflammation and subsequent adhesion of the serous surfaces. The ligature, after cutting its way through the tissues which cicatrise over it, falls into the bowel, from whence it is expelled along with the piece of cork.

Remarks.—The operations that have just been described have not been all performed. To judge of their relative values we must study the conditions on which the success of the operation essentially depends. On one hand, the facility with which serous surfaces unite when brought into contact, on the other hand, the impossibility of securing the direct adhesion of two membranes that differ in their nature, permit of our drawing a well-marked line between the value of one operation and that of another, and all we have to do is to consider which kind of operation offers the most chance of success. The great point is to bring into apposition the serous surfaces of the edges of the wound. Moreover, the surfaces must be brought into exact contact throughout the whole extent of the wound, and the contact should be maintained in such a manner as not to allow of any matter escaping into the abdomen. The diameter of the bowel must at the same time be diminished as little as possible, and no projection of the parts should offer any obstacle to the passage of its contents. Lastly, the fewer the sutures the less constriction there will be, and the less chance of any accidents occurring afterwards.

place just so long as to secure the formation of peritoneal adhesions, and, on the other hand, sufficiently changeable and hygrometric as to become afterwards much softened, and even to be converted into a paste that can be easily expelled by the bowel. Collars of gelatine that have been hardened by means of a coating of some sedative oil answer the purpose very well.

PLATE LIX.

WOUNDS OF THE INTESTINE.

Fig. 1.—*M. Gély's quilted suture.*—The surgeon takes a silk thread that is well waxed and armed with a needle at each end. One of the needles is passed through point b, above, and ⅛ of an inch external to the upper angle of the wound, and is brought out, from within outwards, at point c, a ¼ of an inch below. The second needle enters at point b', and comes out at point c'. The figure illustrates this first step of the operation. The ends, a, a, of the thread are then crossed in front of the wound in such a manner that the thread from point c' re-enters at c, and the thread from point c re-enters at c'. The needles then make their exit at d and d'. Another crossing of the threads is made; that issuing from d' re-enters the bowel at d, as was done above at c' and c. This proceeding is continued as far as ⅛ of an inch below the wound, where the threads are tied in a knot. Externally, the closure of the wound is secured by a double thread, which crosses it in the direction of b, b', c, c', d, d', e, e', and approximates the serous surface of its edges; internally, two threads run parallel with the direction of the wound, b, c, d, e, and b', c', d', e', thus making the union still more secure.

Fig. 2.—*M. Reybard's operation.*—The illustration shows a transverse section of the bowel and of the abdominal wall on a level with the wound: a, a, wall of the abdomen; b, b, b, bowel; c, tablet introduced into the bowel; d, d, d, suture of thread passing through and keeping in apposition the tablet, the bowel, and the abdominal wall.

Fig. 3.—*Transverse wound of the bowel.—M. Jobert's operation.—Apposition of the serous surfaces.*—Two silk threads, *a*, *a*, and *b*, perforate the upper end of the bowel. At the lower end the edge of the bowel has been turned inwards, while the thread, provided with a needle at each end, passes through this inverted edge, and maintains the inversions. When traction is made upon the threads, *a* and *b*, the upper end of the bowel is invaginated within the lower portions, and by this means the serous surfaces are brought into contact.

Fig. 4 & 4 *bis.*—*M. Lembert's operation.*—The number of needles and thread required in this operation must be in proportion to the number of sutures to be applied. One thread, *a*, is inserted at *a'*, and drawn out at *b*; it then passes over the transverse wound, re-enters the bowel at *b'*, and again makes its exit at *c*. The other threads are applied in the same manner.

Fig. 4 *bis.* represents the course of the thread, *a*, *b*, *c*, *d*, *e*, through the wall of the abdomen, *A*. It is only necessary to pull the thread and to tie it in order to bring the serous surface of the edges of the wound into contact with each

PLATE LX.

HERNIA.

SURGICAL ANATOMY OF THE INGUINAL REGION.

Fig. 1.—The skin and the subcutaneous cellular tissue have been raised throughout the whole extent of the region : *a*, *a*, the superficial layer of the subcutaneous fascia. Superficial vessels, *e*, *e*, perforate the meshes, *i*, of the fascia.

Fig. 2.—Deep layer of the superficial fascia; the meshes, *b*, *b*, are large: *d*, *d*, fibres of the dartos; *e*, *e*, *e*, superficial vessels converging towards the crural arch, and passing through the apertures with which the superficial fascia is riddled.

Fig. 3.—The superficial fascia is removed. Below this layer is seen, in the abdominal region, the external oblique, *a*, and its aponeurosis, *b*; and in the crural region, the fascia-lata, *c*, *c*. The cribriform fascia still remains; numerous glands, *e*, *f*, are scattered over this layer, which covers, moreover, the femoral sheath. The subcutaneous fascia of the thigh, *d*, *d*, has been turned back. It covers the ganglions, and becomes united at the crural arch with the subcutaneous fascia of the abdomen. The cribriform layer of cellular tissue, which joins externally the aponeurosis of the fascia-lata, *c*, is a part of the deep layer of the superficial fascia.

Fig. 4.—The cribriform layer is separated from the fascia-lata, *c*, and raised with a tenaculum, *d*. Beneath this layer lie the femoral vessels: the vein, *f*, and artery, *g*, enclosed in a cellular sheath of funnel shape, *e*, *e*. The cavity of the funnel-shaped sheath is divided into three compartments by partitions which separate the artery from the vein. The internal compartment containing a femoral gland is that which is the seat of crural hernia.

PLATE LXI.

CONTINUATION OF THE SURGICAL ANATOMY OF THE INGUINAL REGION.

Fig. 1.—A part of the external oblique, with its aponeurosis, *a*, is removed. Beneath is seen the internal oblique, *b*. The aponeurosis of the external oblique, *c*, detached from its upper part, *a*, is turned down over the thigh. This portion of the aponeurosis is inserted at Poupart's ligament, or the crural arch, which will be described presently (figs. 5 & 6).

Fig. 2.—After the removal of the external and internal oblique muscles, the transversalis muscle, *a*, is exposed; and the inguinal canal, *b*, commences beneath the inferior fibres of this muscle; *d*, spermatic cord seen in the inguinal canal. The aponeurosis of the external oblique, which contributes to the formation of the inguinal canal, being removed, the relations of the cord with the inferior fibres of the transversalis muscle beneath it.—*a*, the bladder drawn down with a tenaculum; *H*, *H*, cut vessels.

The *external inguinal fossa*, *e*, corresponds to the abdominal ring, or to the abdominal orifice of the inguinal canal through which passes the spermatic cord. Internally this fossa is bounded by the epigastric artery, which courses between the peritoneum and the abdominal muscles. This artery (see Pl. XVII.) passes beneath the cord, and is consequently found internal to the hernias which commence at the external fossa (External or Oblique Inguinal Hernias, see Pl. LXIV. fig. 1).

The *internal inguinal fossa*, *d*, is situated between the projection of the epigastric artery, *f*, and the projection formed by the obliterated umbilical artery, *g*. This fossa corresponds to the inguinal canal, and *internal inguinal hernias* (see Pl. LXIV., fig. 2), which, pushing the peritoneum in this direction, appear internal to the epigastric artery.

A third fossa, or *vesico-inguinal* fossa, formed by the projection of the umbilical artery and the projection of the external border of the rectus muscle, corresponds to the external ring or orifice of the inguinal canal. Hernias which commence at this fossa are *direct*. *H*, *H*, crural vessels.

Fig. 5—*Poupart's ligament, or the crural arch.—Gimbernat's ligament.*—*a*, anterior-superior spinous process; *b*, horizontal ramus of the pubis; *c*, *c*, Poupart's ligament, or the crural arch; *f*, anterior-inferior spine of the ilium.

Poupart's ligament, or the crural arch, is formed by a strong aponeurotic bridle extending from the spine of the ilium, *a*, to the spine of the pubis.

Gimbernat's ligament, *c*, is formed by the lowest fibres of the crural arch, which are reflected from before backwards, and are inserted close to the pectineal line, *b*. This ligament, the aponeurotic expansion of the crural arch, by its reflected direction from before backwards, forms a sort of partition which separates the fossæ, described above, from the crural canal. Another ligament, *d*, associated with the crural arch, becomes separated from it, and is inserted upon the ileo-pectineal line. This ligament, the *ileo-pectineal band*, bounds on the outside an orifice that is bounded above by the crural arch, inside by Gimbernat's ligament, *c*, and below by the ramus of the pubis, *b*. This opening gives passage to vessels, and nerves, and crural hernia begins at this spot. If the reader bears in mind that crural hernia always follows the internal compartment of the femoral sheath, he will understand its relations to Gimbernat's ligament, relations of which we shall have more to say hereafter.

Fig. 6.—A tenaculum, *a*, raises the crural fascia; *b*, Poupart's ligament, or the crural arch. The anterior wall of the crural canal is removed, by which the crural artery, *d*, on the outside, and the crural vein, *e*, on the inside, are brought into view; *f*, the spermatic cord coming out of the external ring of the inguinal canal. The explanation of Plates LX. and LXI. will make the following description of the inguinal and crural canals more intelligible.

The inguinal canal.—This canal is a hollow passage through the substance of the abdominal wall, and gives passage to the spermatic cord in the male, and to the round ligament in the female. Its direction is oblique from above downwards, from [redacted] transversalis. The external ring is formed by the separation of the fibres of the aponeurosis of the external oblique. It is between the *pillars* formed by the separation of these fibres that the spermatic cord escapes.

The external pillar is inserted into the spine of the pubis, and the internal pillar into the symphysis pubis. The separation of these pillars is bridled over above and below by transverse fibres, the *intercolumnar fibres* arising from a prolongation of the aponeurotic fibres of the external oblique of the opposite side. The result is that the positions of the body in which the abdominal muscles are contracted tighten the external ring by the tension of the aponeurotic pillars.

The length of the inguinal canal varies from one and a half to two inches. Its direction is parallel to that of the crural arch, which forms its lower wall, and from which it is about half an inch distant. The orifice where the external ring is situated is about an inch external to the symphysis pubis.

In the infant the two rings are closer together, and almost in juxta-position; and, further, the peritoneum often communicates with the tunica vaginalis. Hernias may in that case commence in the canal, and descend into the scrotum without having a proper sac. This anatomical disposition of the peritoneum always places hernias external to the epigastric artery.

In females the inguinal canal only contains the round ligament of the uterus and a few vessels. Its abdominal opening is reduced to a simple cleft, a circumstance which explains the rarity of inguinal hernia in this class of patients, and the frequency of crural hernia.

PLATE LXII.

SURGICAL ANATOMY OF THE SCROTUM, AND OF THE SPERMATIC CORD.

Fig. 1 —*a*, penis drawn to the left; *b*, *b*, *b*, skin of the scrotum; *c*, *c*, *c*, *c*, the superficial fascia lining the skin; *d*, the dartos; *e*, the fibrous tunic or intercolumnar fascia; *f*, the aponeurotic fibres of the external oblique; *h*, the fibrous or proper covering of the cord; *g*, the spermatic cord cut close to its exit from the ring.

Fig. 2.—*Anatomy of the spermatic cord.*—*a*, aponeurotic fibres of the external oblique; *b*, *b*, the intercolumnar fascia arising from the circumference of the inguinal ring; *c*. *e*, cremaster muscle; *d*, *d*, the proper fibrous covering of the cord derived from the cremasteric fascia; *e*, a sound passed beneath the spermatic vessels; *f*, vas deferens.

Fig. 3.—*a*, the testicle; *b*, *b*, *b*, *b*, the tunica vaginalis; *c*, *c*, the fibrous covering of the cord.

This muscle, which is very thin, and which is formed, according to M. J. Cloquet, of the lower fibres of the internal oblique dragged down by the descent of the testicle, forms for the spermatic cord a covering composed of muscular loops, with their concavity above, commencing with a fasiculus of fibres at the circumference of the ring, and joining another fasiculus which is inserted into the pubis.

The *proper fibrous coat* (fig. 1, *h*, and fig. 2, *d*) follows next. It is a prolongation of the fascia transversalis and sub-peritoneal tissue.

In the midst of these coverings are situated the *spermatic vessels* and the *vas deferens*. The vessels are in front of the *vas deferens*. The walls of the latter are strong, thick, and resisting. In the operations that are performed with the view of tying the vessels it is necessary to recognise this duct, and to carefully isolate it.

The *tunica vaginalis* (fig. 3, *b*, *b*) covers the whole testicle except above and behind. Sometimes this pouch, as it may be called, communicates with the peritoneum, of which it is a prolongation. It is often the seat of a considerable effusion of serum (hydrocele), and when there is a communication with the peritoneum, by making pressure upon the swelling the fluid can be made to flow back into the abdomen. The surgeon should always make sure that there is no such communication before he injects any irritant fluids into the tunica vaginalis for the purpose of radically curing the hydrocele.

PLATE LXIII.

A THEORETICAL EXPLANATION OF THE FORMATION OF HERNIAS.

The drawings represent a section passing through an opening in the abdomen, and also hernias of the bowel.

Fig. 1.—*a*, abdominal opening; *b*, *b*, *b*, the bowels pushing before them the peritoneum, *c*, *c*, *c*, *c*, and having a tendency to enter the opening, *a*. Only the peritoneum has commenced to enter the opening, *a*; it is the first step in the formation of the *sac*.

Fig. 2.—The bowel, *b*, *b*, *b*, and the peritoneum, *c*, have cleared the opening, *a*, *a*. Here the process is more advanced than in the first figure; but the sac, *c*, *c*, *c*, *c*, has not yet become narrow or contracted at the opening; its neck is not yet formed.

Fig. 3.—*b*, *b*, the *herniated coil of intestine* enclosed in the *peritoneal sac*, *c*. The sac is dilated into a pouch or bladder,

PLATE LXIV.

SURGICAL ANATOMY OF HERNIAS.

Fig. 1.—*External inguinal hernia and its coverings.*—The incision through the skin, the subcutaneous cellular tissue, and the superficial coverings, *a, a*, bring into view the aponeurosis of the external oblique, *b;* the fibrous coat, *c*, covered by the origin of the fibres of the cremaster. Below is the hernial sac, *d*, formed by a portion of peritoneum, in which is seen the epiploon, *e*, with a coil of intestine, *f*.

Fig. 2.—*Internal inguinal hernia.*—The skin and the subcutaneous cellular tissue has been removed, *a ;* along with a portion of the aponeurosis of the external oblique, *b*, the peritoneum, *c*, is exposed; the commencement of the spermatic cord, *d ;* the epigastric artery, *e*, passing beneath the cord; a hernial sac laid open, *f*, situated inside of the artery, and enclosing a coil of intestine, *g*.

Fig. 3.—*Crural hernia.*—The skin of the abdomen, *a*, being to a great extent removed, the aponeurosis of the external oblique, *b*, is exposed, as well as the spermatic cord, *c*. Below the crural arch will be seen the femoral vessels, *d ;* and internal to these vessels a hernial sac, *e*, laid open, and containing a coil of intestine, *f*. To complete the anatomical description of the inguinal region, see Plates XVI. and XVII.

PLATE LXV.

RADICAL CURE OF HERNIA.

Figs. 1, 2, & 3.—*M. Gerdy's operation.*

Fig. 1.—The operator introduces the index finger of his left hand into the inguinal canal, and folds back the skin of the scrotum. A needle-carrier, *a*, passed over the finger as far as the bottom of the cul-de-sac, perforates, from within outwards, both it and the anterior wall of the inguinal canal, and at the same time carries outwards the first loop of thread, *b*.

Fig. 2.—Having passed the first double thread, *a*, the needle-carrier, *b*, is inserted in another direction, carrying the same thread through a little lower down, *c*.

Fig. 3.—The threads are tied over two quills, *a* and *b*, and the loop which they form maintains in the inguinal canal the organic plug produced by the skin of the scrotum, folded back like the finger of a glove.

choice of the bandage and the form of the cushion. It is an essential point to close the hernial orifice exactly, but without forcing it in, and without pressing too much upon the skin.

It may be worth while here to mention *cauterization* of the neck of the sac, as formerly practised by the Arabian surgeons; *incision* of the sac, condemned by J. L. Petit and by Potts; *incision* of the sac described by Celsus; *ligature of the neck* of the sac in order to produce the mortification and separation of the covering of the hernia, etc. These operations, however, have been long abandoned; in this place only the more modern methods will be described.

M. Belmas' operation.—The object of the operation proposed by M. Belmas is to obliterate the hernial opening by setting up inflammation of the walls of the sac through the introduction of a foreign body within its cavity.

The first method adopted by M. Belmas consisted in introducing into the interior of the sac, by means of particular instruments, a small pouch of gold-beater's skin, which he inflated. This pouch, by filling up the sac, kept the hernia reduced, and set up adhesive inflammation, which was followed by the complete obliteration of the hernial opening. For this operation, which is rather difficult of execution, M. Belmas substituted an analogous but much more simple one. He used gelatine threads in place of the pouch of gold-beater's skin, the presence of which suffices to inflame the sac; the threads then become absorbed, and the adhesions remaining, the obliteration was complete. Out of ten operations, five were successful, three were partially successful, and two were failures.

M. Gerdy's operation (Pl. LXV., figs. 1, 2, & 3).—This operation is only applicable to inguinal hernia. It consists in obliterating the opening with an organic plug formed out of the skin which covers the hernia, and fixed with sutures. The operator pushes up the skin of the scrotum into the ring and into the inguinal canal with the index finger of his left hand (fig. 1); while, with his right hand, he takes a particular kind of needle-carrier, and passes it over the finger which keeps the

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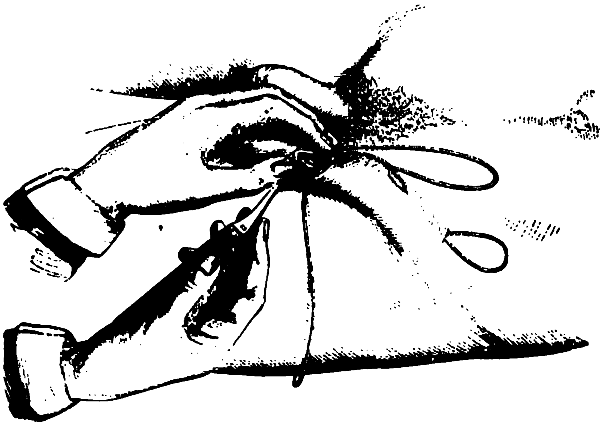
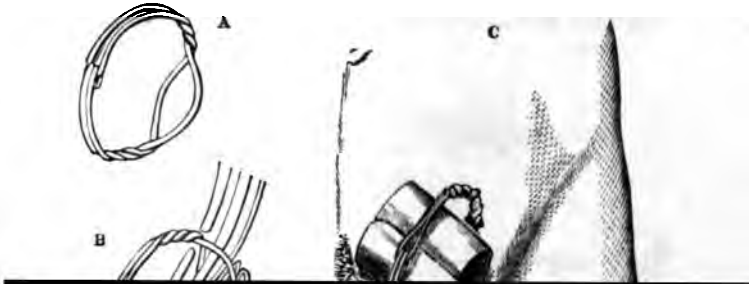
scrotum, about 1½ inch in length obliquely downwards and outwards over the fundus of the sac. The integument is then raised from the subjacent fascia, for an area of about two inches in diameter. The detached fascia is now invaginated in the inguinal canal, as high up as the internal abdominal ring, by means of the forefinger of the operator. The forefinger which is supporting the invaginated fascia raises the lower border of the internal oblique muscle and conjoined tendon, and in front of them the inner pillar of the superficial ring; the needle being passed along the finger behind and through the conjoined tendon and internal pillar, the skin is next drawn inwards, and the needle pushed through it, so that the aperture in the skin is somewhat external to that in the conjoined tendon. One end of a piece of stout *copper wire, silvered*, about two feet in length, is then engaged in the needle and drawn through to the scrotal wound. The needle being disengaged from the wire, is passed along the outer side of the forefinger, nearly as high up as the internal abdominal ring; it is then pushed through the external pillar of the external ring, that is to say, through the aponeurosis, close to Poupart's ligament, and, by drawing the skin outwards to



meet it, brought out through the same cutaneous opening. Here the other end of the wire is engaged, and the needle again withdrawn, so that a loop of the wire then appears in the single cutaneous aperture, and the two ends of the wire in the scrotal wound, one perforating the conjoined tendon, the inner pillar of the ring, and the invaginated fascia, the other perforating the external pillar of the ring and the invaginated fascia.



through, either puncturing the sac, or, if possible, passing altogether behind it. The loop above should be twisted, and the two free ends below should be twisted several times, so as to contract the space enclosed within the wires, *A* and *B*; (fig., p. 280); and lastly, a pad of bandage being placed over the spot, the twisted ends are passed through the loop and drawn over the pad, and a spica bandage is applied over all, so as to press firmly upon the wire, *C*.

Mr. Wood records 235 cases operated upon, of which sixty-five per cent were radically cured. Of the earlier cases three died from hospital causes, pyæmia and erysipelas, but since adopting the use of wire no deaths have resulted.

Remarks.—All the operations that have been tried up to the present day, with the view of radically curing hernias, are far from being free from danger ; the advantages to be gained do not compensate for the risk and the dangers incurred in performing them. Further, they aim at obliterating the sac without strengthening the abdominal wall, and therefore, if successful, they effect only a temporary cure. Now considering that an indolent hernia is not attended with any imminent peril, the prudent surgeon will decline performing operations that are frequently unsuccessful, and often fatal. On the other hand, experience shows that compression, practised in a methodical manner by means of a bandage, in many cases effects a radical cure. M. Malgaigne has seen an inguinal hernia cured in an old man of seventy-six years of age, by completely obliterating the inguinal canal by means of simple compression alone. The records of this kind of cure are sufficiently numerous to encourage the exclusive adoption of a method which is not attended with any inconveniences.

GENERAL STUDY OF HERNIAS.

The following remarks apply to inguinal, crural, and umbilical hernias only:—

Every hernia presents for consideration : (1) the protruding parts; and (2) the coverings of these parts or hernial sac.

The ***omentum*** and the ***small intestine*** form the majority of hernias which enter the inguinal canal, the crural canal, or the umbilicus.

If the bowel alone is displaced (enterocele), the hernia forms a rounded tumour of variable consistence, according as the bowel is full or empty. It is elastic, tympanitic on percussion when the gut is full of gas, more or less soft when it is full of fecal matter.

When the hernial tumour is composed of the omentum (*epiplocele*) alone, it is soft, doughy, and unequal on pressure. This kind of hernia is not often attended with symptoms in the region of the digestive passages as is the case in hernias of the bowel. Lastly, the tumour sometimes consists of both bowel and omentum (*entero-epiplocele*).

We have already noticed (Plates LXIII. and LXIV.) the formation of hernias and the different anatomical layers that form its envelope.

The true *sac* then consists of those layers folded over the displaced parts. The number and nature of the different or without adhesions. A hernia is reducible when it is easy to push the displaced organs back into the abdomen. In this case the neck of the hernial sac is sufficiently large to admit of the return of either the bowel or the omentum, which do not then contract any adhesions either with the neck or with the bottom of the sac. Hereafter we shall study the operative measures (taxis) by which hernias are reduced.

Irreducible hernia is that in which the sac or the neck of the sac have contracted adhesion with the protruded organs.

OBSTRUCTION.

When fecal matters collect in a coil of protruded bowel and distend it, the hernia is said to be *obstructed*. Obstruction is very apt to occur in old men, and when hernias are old and much dilated. Obstructed hernias are very painful; and to the touch they closely resemble a fatty tumour. The taxis will generally succeed in reducing them; but when the obstruction is persistent, and the hernia remains for a long time irreducible, it may then end in actual strangulation.

STRANGULATION.

A hernia is said to be strangulated when the opening through which it passes is too tight or narrow to admit of its reduction, and when the protruded part is inflamed. This inflammation, which is the result of the strangulation, becomes itself a cause of constriction by increasing the volume of the parts involved in the hernia. Then follows a secretion of fluid, with adhesion to the neck and in the interior of the sac. The inflammatory process may take its usual course, and may terminate in mortification of the hernia. Before, however, this takes place, the surface of the bowel always presents a smooth appearance, with a violet tint occasioned by a stagnation of venous blood. Later on, this colour turns blackish, and, when the mortification has commenced, of a grey ashy colour, with fibrinous deposits.

SEAT OF THE STRANGULATION.

Richter thought that the seat of the strangulation was always at the aponeurotic rings, and that a spasmodic contraction prevented the return of the parts concerned into the cavity of the abdomen. But since then a more attentive study of the morbid anatomy of hernias has shown that in the great majority of cases strangulation takes place at the neck of the sac. This last opinion is adopted by M. Malgaigne to the exclusion of any other. According to this surgeon, when actual strangulation has taken place, it is always found to be at the neck of the sac. Nevertheless, the aponeurotic rings are also a cause of strangulated hernias, a cause which does not exclude the constriction occasioned by the neck of the sac, except in recently-formed hernias, where the neck of the sac is not thickened.

It may happen that the neck causing the strangulation is free in the abdominal opening; and in that case, if the hernia is reducible, the strangulation may continue after the hernia has been returned into the cavity of the abdomen.

The neck of the sac and the aponeurotic rings are not the

the pulse is small and frequent; and the pinched appearance of the features indicate the extreme uneasiness of the patient.

3rd period.—The inflammation is at this stage succeeded by gangrene. The pain now ceases; the vomiting is replaced by hiccoughs; the body is covered with a cold perspiration, and the temperature declines to about 96°; the features undergo a change, and the face becomes livid; the pulse becomes small, thready, and intermittent; the voice is trembling; and the swelling assumes a reddish appearance, and often crepitates under the finger. The bowel may then return into the abdomen, and a rapid and fatal effusion of fluid takes place in the peritoneal cavity. At other times, the swelling ulcerates and bursts externally; in this case the open bowel remaining adherent to the external wound may give rise to an ***accidental artificial anus.***

The symptoms above mentioned will enable us to form a differential diagnosis between a hernia that is simply obstructed and one that is strangulated. Whatever may happen, the surgeon should always try the taxis before resorting to the division of the stricture, especially if the strangulation is recent. But if the hernia is old and very painful, it is better not to increase the inflammation by unseasonable manœuvres, but to resort at once to an operation which, if put off, may be no longer serviceable.

TREATMENT OF HERNIAS.

The treatment of simple hernia is either palliative or curative.

The palliative treatment consists in preventing any accidents occurring, by keeping the hernia reduced by means of a bandage.

The object of the curative treatment is to radically remove the condition.

Another chapter will be devoted to the consideration of the different plans and operations (taxis and kelotomy) which are called for by the accidents to which hernias are exposed.

Trusses.—The application of a truss keeps the parts reduced, and thus prevents the accidents with which hernias may be complicated, such as irreducibility, obstruction, strangulation, etc. Trusses may also, under certain conditions with regard to the age of the patient and the character of the hernia, be the means of effecting a radical cure.

It is therefore of importance to duly recognize what their size and form should be, in order to derive the greatest possible benefit from them. The only trusses now used consist of a steel band, well lined, covered with wash-leather, and terminating in a fixed or movable cushion, and of a shape that is most suited to the nature of the case. Formerly a soft kind of truss was in use, made of leather, cloth, or some other non-metallic substance. These trusses were fixed on by a soft girdle, while a spring fastened to the cushion kept up the necessary degree of pressure.

The cushion of the truss should be made of rather soft material; but sometimes it is made of wood, ivory, india-rubber, spring-pads, water-pads, air-pads, etc. The union of the spring or the body of the truss to the cushion is called its neck. On the plate which supports the cushion there are walk a few paces, and move the body in different positions, so as to see whether the truss fits well to the hernia.

When the truss is applied to a crural hernia, the cushion should be carried below Poupart's ligament. M. Malgaigne thinks that movable cushions have, in a certain number of cases, an advantage over fixed cushions; that in oblique inguinal hernia the cushion should press over the course of the canal and over the internal opening, resting very little or not at all upon the pubis, according to the nature of the case; that in direct hernias the cushion should be more voluminous, fixed, and adjusted to the pubis; and that hard cushions are more useful for maintaining pressure upon the canal, and soft cushions for direct hernias.

REDUCTION OF HERNIAS.

Taxis.—By taxis is meant a series of manœuvres by which the surgeon is enabled to return the displaced parts into the cavity of the abdomen. It is by manual assistance, applied directly to the swelling, that the reduction of the hernia is effected by means of this operation.

Position of the Patient.—The best position is that in which the abdominal muscles are completely relaxed. Let the patient, therefore, lie on his back with his head and shoulders raised on pillows. The pelvis should also be raised in such a manner that the patient's back, being in a declivitous position, the swelling is a little above the level of the abdominal cavity. In this position, the bowels will not exert any pressure upon the ring through which the hernia has to pass. Lastly, raise the thighs and flex the legs upon them.

General rules.—Before describing the different manœuvres especially adapted to this reduction of particular hernias, the attention of the reader may be drawn to the general rules which, according to M. Malgaigne, it is necessary to observe in the great majority of cases—1. Draw off the urine in order to increase by so much the capacity of the abdominal cavity. 2. Make the patient breathe freely without screaming or moving his head—a movement which he is very apt to make for the sake of watching the operation—in short, he must make no effort of any kind. 3. Make at first gentle pressure so as to be able to increase it gradually, and to continue it for a long time without bruising the hernia. 4. Return those parts first which were the first to be protruded. 5. Take care that the protruded parts are returned by the same channel as that through which they were protruded. Thus, in recent inguinal hernias, the bowel should be at first pressed directly backwards in order to pass the first ring, then backwards, upwards, and especially outwards, in accordance with the course of the canal ; and, lastly, from before backwards again, when it may be presumed to have arrived at the second ring. In congenital or old hernias it is enough to press the parts backwards and a little upwards. 6. And lastly, in certain exceptional cases, these rules do not hold good, and patients have themselves a method of procedure which it is as well to follow.

OPERATION.

It is very difficult in an operation of this kind to adopt one method exclusively. The attempts that are made to reduce a hernia always admit of the simultaneous or successive adoption of the different methods of reduction described by authors. The great point is to return the hernia by the same channel through which it was protruded. When the reduction takes place, the hernia may gradually diminish in volume and in hardness, and then pass back all at once. Sudden reduction, which is usually accompanied by a gurgling noise, is a sign of an intestinal hernia. A hernia of the omentum is generally reduced without any noise, and in a more gradual manner.

Duration of the Taxis.

If the taxis be too prolonged, it may compromise the success of the operation for the division of the stricture which may be rendered necessary in consequence of the failure of the attempts made to reduce the hernia. M. Amussat, on the other hand, is in favour of the taxis being prolonged and complete. This question, however, cannot be absolutely decided from *à priori* consideration. The surgeon, therefore, must draw from the peculiar circumstance of each case the indications which should regulate his conduct in this respect.

PLATE LXVI.

OPERATION FOR DIVISION OF THE STRICTURE (KELOTOMY).

Fig. 1.—A fold of skin is raised over the tumour, transversely to the axis of the groin. This fold of skin is held on the inside by an assistant, and on the outside by the left hand of the operator, who, with his right hand, cautiously makes an incision into the fold. The incision may be made from within outwards, by plunging the instrument, with its sharp edge upwards, into the base of the fold.

Fig. 2.—The above incision (fig. 1) has merely involved the skin and the subcutaneous cellular tissue. When the edges of the wound are separated, the swelling, *a*, is exposed enveloped in its several coverings, which are next divided layer by layer with the bistoury, *b*, guided over a director, *c*.

Fig. 3.—Having divided in succession all the coverings of the hernia, the operator raises a fold of the hernial sac with a [redacted]

The *instruments* required for this operation are—an ordinary straight bistoury or scalpel, the hernial knife of Pott or A. Cooper, also a director, a pair of scissors, a pair of mouse-toothed forceps, and one or two pairs of dissecting forceps. Several fine sponges should likewise be at hand to absorb the blood during the operation. Lastly, several pieces of dressing, lint, bandages, etc., should be provided.

The *poitsion of the patient* should be such as to completely relax the abdominal muscles. He should, therefore, be placed horizontally on a couch, with his thighs half flexed, his legs flexed upon the thighs, and his shoulders slightly raised upon a pillow. The part to be operated upon should be shaved if necessary. The operator should stand on the hernia side of the patient, with his assistants near him on the opposite side, to hand the instruments, stanch the blood with sponges, and take any other part in the operation that circumstances may render desirable.

As the object of this operation is to remove the strangulation by dividing the stricture which causes it, it naturally consists of several principal steps in which the surgeon divides in succession first, the skin; second, the subcutaneous coverings of the hernia; third, the hernial sac; fourth, the stricture itself; while the reduction of the bowel constitutes the fifth and last step in the operation.

First Step.—Incision of the skin (Plate LXVI., fig. 1).—The incision should be made in the long axis of the tumour, and to an extent proportionate to the size of the hernia. It may be made from within outwards, or from without inwards; and when the skin is intimately connected with the coverings of the hernia, and cannot be raised into a fold between the fingers, the incision should be made very cautiously. The essential point is not to wound the bowel. When the skin is soft, not much adherent to the subjacent parts, it is best to raise up a fold of skin over the tumour. The operator, holding one end of this fold, while an assistant holds the other, makes an incision into it from within outwards, or *vice versâ*, by plunging into its base a bistoury with the blade held upwards. This incision divides the skin only; it should extend nearly ½ an inch above the swelling. It is sometimes advisable to make a crucial or T-shaped incision.

This first step in the operation is generally followed by a little hæmorrhage from some of the superficial vessels, which it is as well to arrest before continuing the operation by torsion of the bleeding vessels, or the application of cold water.

Second Step.—Division of the subcutaneous coverings of the sac.—This step of the operation must be performed with great caution. Some surgeons make a direct incision from without inwards by passing over the surface of the tumour the sharp edge of a bistoury held like a fiddle-stick. The safer method, however, is to raise with a pair of forceps the membranous coverings of the hernia, and then to perforate separately each fold seized by the forceps. Through the small opening thus made a director should be inserted beneath the layer as far as each extremity of the tumour, while with a bistoury guided by the director, and with its sharp edge upwards, the surgeon divides one by one the coverings of the hernia as far as the sac. The number of the coverings of the sac is variable, and we have already enumerated and of the bowel if seen through the transparent sac—an operation which is generally facilitated by the presence of the serum which bathes and distends the inside of the sac. An incision should then be made into the fold close to the forceps in order to make an opening into which a director can be inserted. Guided by the director, the sac is then to be opened both above and below to a sufficient extent, but it is an object to expose the bowel as little as possible. This opening of the sac should be effected as much as possible in front of it, and a little to the outside. It is of the utmost importance to make certain that the sac is really entered. The escape of a certain quantity of serum after the sac has been opened; the facility with which the interior of the sac can be explored, either with the finger or the director (provided, of course, there are no adhesions between it and the bowel); the fact of the bowel or the omentum freely floating, and not being adherent to anything except the seat of the stricture,—all these signs combined will scarcely leave any doubt as to the nature of the pouch or sac which has been opened. We may add, however, that some hernias (hernia of the cæcum, for example) have no sac. Should this embarrassing peculiarity present itself, which is very rarely the case, the bowel may always be readily recognized by the structure of its coats.

Generally speaking, the bowel appears of a variable colour, according to the time that has elapsed since the commencement of the strangulation. Its surface is vascular, of a more or less deep, reddish-brown, or even black colour, and perhaps masked in some places by a layer of plastic lymph. The omentum may be easily unfolded when there are no adhesions. Figs. 4, 5, & 6 represent a coil of protruded bowel after the opening of the sac.

Fourth Step.—The division of the stricture.—Before proceeding to divide the stricture, the neck of the sac should be explored with the finger, and gentle traction made upon the protruded bowel, with the view of reducing it, if possible, without dividing the stricture.

Having discovered the seat of strangulation, and that the stricture must be divided, the operation may be accomplished in two ways: first, by dividing the stricture to a sufficient extent, and on the side where there is no occasion to fear the presence of any blood-vessels; second, by making several incisions at different points of the seat of stricture,—a mode of procedure that has been methodized by M. Vidal.

The division should be made with a hernia knife; the sharp edge of the instrument should be inserted beneath the stricture, being passed along the index finger, or over a director (figs. 5 & 6). When there is no room for the insertion of the finger, the director must be used; but if the nail can be introduced beneath the constricting band, the bistoury should be passed over the finger, first in a flat or horizontal position, and then by raising the sharp edge upwards, and at the same time pushing the back of the instrument with the finger on which it rests, the division of the stricture is accomplished. Afterwards the index finger may be passed in more deeply, so that it may be possible to carry the division a little further. During the operation the assistants should not only keep the should be made before resorting to an operation for the division of the stricture; but it should not be forgotten that the seat of strangulation is more often at the neck of the sac than at the aponeurotic ring. In certain cases, therefore, the hernia may be returned along with the sac, reduced *en masse*, a circumstance which would of course involve the continuance of the strangulation after the reduction of the hernia. Consequently, the surgeon should be sure about the precise seat of the stricture. Nor should it be forgotten that some hernial sacs have multiple necks, and that the seat of strangulation may be very extensive, and may reach as far as the upper ring of the inguinal canal. It is only by repeated explorations and divisions of strictures that the operator will be able to discover the difficulties that may be encountered in operations of this kind.

There is a difference of opinion amongst authors as to the direction, and the extent to which the division should be carried. When the seat of the strangulation is at the external ring, and when the neck of the sac can be drawn out of the canal, the division is easy of execution, and there is no risk of wounding the epigastric artery. But when the stricture is more deeply situated, the impossibility of knowing whether the hernia is internal or external should induce the surgeon to act cautiously.

The reader should refer back to Plates LV., LVI., & LIX., for a description of the more important anatomical relations of the parts concerned in the production of hernias. The division of the stricture in an upward direction is less dangerous as respects the viscera that have to be avoided: and by not carrying the incision beyond ⅛ of an inch in extent, there is no risk of wounding the artery. In the case of external hernias, the division outwards allows of its being safely carried to a greater extent, and in proportion to the volume of the displaced viscera. For this reason it will be often advisable to have recourse to the multiple division recommended by M. Vidal.

Multiple division.—Where it is necessary to enlarge the abdominal opening, and with the view of avoiding such an extensive incision as would incur the risk of hæmorrhage, M. Vidal proposes three, four, or even a greater number of incisions of $\frac{1}{12}$ to $\frac{1}{8}$ of an inch in length.

M. Malgaigne's operation.—M. Malgaigne does not make the first incision over the sac and the scrotum, but over the apparent seat of strangulation, prolonging the incision upwards and downwards to such an extent as the obesity of the patient and the volume of the hernia may render advisable. All the tissues are divided as far as the peritoneum, and in this way he has nothing to fear from the presence of blood-vessels, which are kept under the eye, or removed out of the way. If the strangulation is found to arise from the constriction of a fibrous aperture, the sac itself is not touched, and the hernia is reduced. Otherwise he divides the neck by small incisions from without inwards; or if the stricture appears very tight, he makes a small incision in the peritoneum, either above or below the neck of the sac, and raises the latter with a director on which the neck is divided.

According to M. Malgaigne, the advantage of this plan over

When the bowel is also accompanied by a portion of omentum, the latter should be returned last of all. When a part of the bowel has become gangrenous, the indications for treatment will vary according to the extent of the mischief. If there is any doubt as to the existence of gangrene, M. Vidal recommends a very slight and superficial incision to be made over the diseased portion of bowel. If the circulation is still active, a large drop of blood collects on the little wound, if on the other hand the bowel is gangrenous, the surface of the wound remains dry : in the first case the part may be reduced, in the second it should not. Where there is any doubt, the diseased part should be kept on a level with the ring ; and should it be gangrenous, the fecal matters will find their way through the abdominal opening.

It sometimes happens that in making the small incisions above mentioned, the bowel is perforated by the bistoury. In that case the surgeon must have recourse to one of the operations already described (Wounds of the Bowels), according to the nature and extent of the wound. Lastly, when the bowel is gangrenous to a great extent, the two sound portions or ends of the bowel must be fastened to the ring, to facilitate the passage of the fæces through the upper end and through the abdominal opening, by which means an artificial anus will be established, and slowly heal. Perhaps, too, it might be possible to excise the gangrenous part, to unite the sound parts by suture, by one of the operations described, and then to reduce the bowel.

Whenever it is necessary to establish an artificial anus great care must be taken to preserve the adhesions which unite the end of the bowel to the neck of the sac. The destruction of these adhesions will expose the bowel to the accident of returning into the cavity of the abdomen. If the stricture should prevent the fecal matters from freely escaping outside, a small female speculum might be introduced into the upper end of the bowel, and if this procedure is impossible, or attended with too much danger as respects the integrity of the adhesions, the sac may be cautiously divided on the outside.

The treatment of a gangrenous condition of the omentum depends upon its extent and volume. When the gangrenous portion is pretty extensive, unfold the omentum, cut off all the diseased portion, tie one by one the bleeding vessels, and confine the sound parts, tied as above, to the opening of the ring.

Dressings.—Having well cleaned the depths and the edges of the wound, the latter should be approximated by sutures, and an antiseptic dressing, with a pad of lint and a spica bandage, applied; but if it has been found necessary to establish an artificial anus, the wound must be left open, and a charcoal poultice applied.

CRURAL HERNIA.

The detailed description (pp. 267, *et seq.*), and the illustrations (Plates LX., LXI., & LXIV.) that have been given of crural hernia will be sufficient to show its anatomical relations. When the extra-peritoneal portion of the cæcum and the sigmoid flexure of the colon is the part protruded, the hernia so formed has no sac. But not counting these exceptional cases, crural hernia is composed of much the same elements as in-

OPERATION.

One great aim of the operator is to reduce the hernia without opening the sac. This can only be accomplished when the constriction is not constituted by the neck of the sac. If, therefore, the hernia has not descended on any previous occasion, the neck of the sac will assuredly not be the constriction. And again, if the knuckle of intestine constricted is small, which is the case in the majority of femoral hernias, it is not likely to be the neck of the sac which prevents its return. In all such cases an attempt to reduce the hernia without opening the sac should be made, unless the length of time since the strangulation took place or the symptoms shown by the patient give rise to the opinion that the bowel is gangrenous, and not in a fit state to be returned into the abdomen.

The most convenient incision is one commencing about ½ an inch above the spine of the pubes and carried downwards, in the course of the tumour—somewhat on its inner side—to a sufficient length, according to its size. As the different coverings of the hernia are by no means thick, they must be cautiously divided; and it is often impossible to raise a fold of skin from the tumour. The *fascia propria* enveloping the sac is very thin, and may be mistaken for the sac itself—an error easy to fall into, from the fact that fatty masses folded over the sac, and seen through the transparent fascia, may be mistaken for the omentum, whilst the fascia itself is easily separated from the tissue around, and when so separated presents a ball-like appearance, much in character like the hernial sac. Having determined that the layer under observation is the fascia propria, it should not be separated from the tissue around, for by so doing it is rendered liable to slough; but it should be laid open on a director throughout its length, and thus the subperitoneal fat and cellular tissue is brought into view. The subperitoneal layer is often a mere film of connective tissue; but in fat persons, and in persons in whom the hernia has long existed, it presents important and often perplexing variations. If this covering be simply a connecting lamina, the sac is plainly visible; but if containing fat, it may have increased to a thickness of a quarter or half an inch, or even more, and may possibly also contain a number of small serous cysts, each one of which may, when first seen, present the appearance of the sac containing fluid. This loose tissue should be cautiously divided until the sac of the hernia is exposed.

The rest of the operation differs only as to whether or not it has been determined to open the sac. If not, then the finger nail may be carried along the inner side of the sac to Gimbernat's ligament, beneath which it may be pushed to serve as a guide for the hernia knife. Gimbernat's ligament is then to be incised, together with the fibres of fascia propria, by cutting directly inwards, or inwards and upwards, from the hernia, one or two notches being made according to requirement. Now the hernia may be pressed upwards from the sac into the abdominal cavity, the sac itself being retained in its original position. Should it not be possible to empty the sac of the hernia, the rest of the operation may be proceeded with. The sac is to be cautiously raised by a pair of tren, this plan has been condemned by Sabatier, Scarpa, and A. Cooper, who have taxed it with the production of convulsions in children and inflammation of the sac.

Kelotomy.—Umbilical hernia may be obstructed or strangulated, so that an operation is imperative. It must not be forgotten that the coverings of this hernia are very thin, and that the sac contains little or no fluid. The operation, therefore, is rather a delicate one. A + or T-shaped incision should be cautiously made; and as, in this kind of hernia, the neck of the sac is very rarely the seat of strangulation, some authors advise only the fibrous ring to be divided, without touching the sac, so as not to expose the peritoneum to subsequent inflammation. This recommendation is a good one, and should be followed when the hernia is large and when it is not necessary to examine the viscera. A longitudinal incision should be made in the median line, commencing an inch or more above the tumour; the nail may then be inserted between the tumour and the ring, the tumour being drawn well downwards, and the linea alba may be cautiously cut through towards the finger nail. Multiple division is preferable to a single division of the stricture; but if only one is made, its direction should be upwards and to the left, in order to avoid the remains of the urachus and the umbilical vessels.

PLATE LXVII.

ACCIDENTAL ARTIFICIAL ANUS.

Fig. 1.—*Artificial anus opening inside by two orifices.*—The upper end of the bowel, *a*, and the lower end, *b*, open into the bend of the groin, each by a cutaneous orifice, *d* and *e*; *c*, mesentery.

Fig. 2.—*Artificial anus opening outside by one orifice.*—*a*, upper end of the bowel; *b*, the lower end, terminating in a cul-de-sac; *c*, partition formed by the approximation of the walls of the two ends; *d*, external orifice of the upper end.

Fig. 3.—*Diagrams showing the formation of the spur or partition.*—*a*, the upper, and *b*, the lower end of the bowel; *c*, the partition or spur formed by the juxtaposition of the walls of the two ends; *e*, mesentery; *d*, external orifice of the upper end.

In this figure, the partition, *c*, descends as far as the external

ACCIDENTAL ARTIFICIAL ANUS.

PATHOLOGICAL ANATOMY (Pl. LXVII.).

When treating of the accidents incidental to strangulated hernia, we stated that it may terminate in gangrene of the bowel, and the external discharge of the fæces through a fistulous wound situated within the fold of the groin. This solution of continuity gives rise to a permanent communication between the bowel and the outside of the body, giving passage to the contents of the bowel by another opening besides the natural one, and constituting an infirmity which is called an *accidental artificial anus.* We shall now notice the surgical operations which have been resorted to with the view of combating this infirmity, reserving for future consideration the operation for *artificial anus.*

It is of the greatest importance to understand the disposition of the ends of the bowel above and below the solutions of continuity; as upon this disposition the curability of the affection depends. Sometimes the accidental anus is formed by a number of small openings more or less distant from the bowel; sometimes the upper and lower ends of the bowel are supported one against the other, like the barrels of a double-barrelled gun, having a parallel direction, and opening externally by two separate apertures. Fig. 1 of Pl. LXVII. shows this disposition of the parts: *a*, the upper, and *b*, the lower end, *d* and *e*, the two external openings corresponding to the two ends of the bowel.

The upper end of the bowel may open externally by only one aperture (fig. 2, *d*), and the lower end may be supported by it, and at the same time be separated from it by the partition, *c*.

The partition or spur.—This disposition of the parts is brought about by the peculiar adjustment of the two ends of the bowel (fig. 3). Their walls, *e*, supported one against another, constitute a sort of valvular partition, which prevents the free passage of their contents from the upper, *a*, into the lower end, *b*. This partition has received the name of the spur·

Further on will be described the operations performed for the purpose of destroying this partition, and re-establishing a communication between one portion of the bowel and the other.

The membranous funnel.—The mesentery, in consequence of the tractions which it makes upon the bowel, has a constant tendency to drag it back into the abdomen, and to separate it from the abdominal wall. The spur, obeying this retrograde movement of the bowel, gets removed from the abdominal opening. The cellular tissue uniting the bowel to this opening gives way a little, and then there is formed beneath the spur a sort of hollow space (fig. 3 *d'*), through which the fæces pass, without being discharged externally, and without meeting with any obstacle from the presence of the spur. In this way the contents of the bowel have a free passage from the upper end, *a'*, to the lower end, *b'*, and the accidental anus undergoes a spontaneous cure.

Scarpa has given the name *membranous funnel* to this passage, which, being formed little by little, naturally and gradually effects the cure of these accidental anuses. Fig. 4 is have also been designed, the form of which must vary according to circumstances. A plate of ivory or of wood may be used to support the edges of the wound, and may be pierced in its centre with an aperture which can be opened or closed at pleasure.

A communication may also be maintained between the two ends of the bowel by means of a large gum-elastic tube, one extremity of which is inserted in the upper end of the bowel, and the other in the lower end ; so that the fecal matters can pass through the tube from one end of the bowel to the other. It will be unnecessary to describe in detail all the apparatus that have been designed in order to lessen the inconvenience resulting from an artificial anus. All these half-measures but badly fulfil the object we have in view, and the distressing infirmity which they still leave exposed to serious dangers calls for operative measures of a curative nature.

Curative treatment.—Before attempting the obliteration of artificial anus, the surgeon should remove the complications by which this affection is frequently accompanied.

When the skin is riddled with holes they may at once be thrown into one. Sometimes there is prolapse of the bowel, and inversion of the mucous membrane, in which case the taxis should be applied, and the reduction effected by making methodical pressure from the summit to the base of the extrusion. Should the reduction of the bowel be impossible, an operation must be resorted to, dividing the abdominal opening by small multiple incisions from the skin towards the peritoneum.

When this first step in the treatment has been accomplished, the spur or partition above mentioned must be destroyed, with the view of facilitating the passage of the fæces from one end of the bowel to the other, as well as the obliteration of the external wound.

Destruction of the spur—Desault's operation.—This surgeon began the operation by dilating the two ends of the bowel with charpie tents, the size of which was gradually increased ; five days often elapsed before the dilatation was complete. He then introduced into the wound a conical plug, which, pushing back the spur in the direction of the abdominal cavity, left the two ends of the bowel facing each other. When the fecal matters were able to pass freely from one end of the bowel to the other, gentle pressure, made over the external wound only, prevented the escape of the fæces externally, and gradually led to the cicatrization of the parts.

Desault also used an ebony holder to push back the spur. Both these proceedings may give rise to flatulence, colicky pains, the retention of the fæces, and other inconvenience.

With the view of not interrupting the passage of the contents of the bowel, M. Fayet, and afterwards M. Colombe, proposed to replace the plug and the ebony holder by a gum-elastic tube of large calibre. The body of the tube compresses the spur, while its extremities engaged within each end of the bowel allow of the free passage of the fæces. This operation was performed by M. Velpeau, but the patient died three days after from peritonitis.

Compression, however, is generally insufficient. It cannot be made in a methodical manner, for there is no power of support on the part of the abdominal wall, and as the spur ment, and gradually compressed it, so as to make it mortify and fall off from the wall of the bowel.

The enterotrite is composed of two blades, which can be introduced separately, one into the upper, and the other into lower end of the bowel. The blades are then joined together, as in the case of the midwifery forceps. A screw serves to close the blades. The pressure made by the instrument secures in the first instance the adhesion of the adjoining walls of the bowel, and subsequently the division and separation of the compressed parts. The instrument is fixed by bandages to prevent its moving about or making painful traction upon the bowel. At the end of the seventh or eighth day the division is complete, and the enterotrite falls off of itself.

Delpech has proposed an enterotrite the ends of which are terminated by enlargements resembling one-half of a nut-shell. These forceps, much larger at their extremity than those of Dupuytren, are not easily applied.

M. Liotard has designed an enterotrite terminated by two oval rings, 1½ inch in length by ¾ inch in width, and one of which, hollowed out by a fluting, receives a corresponding projection of the other. The two blades only meeting at their rings, the latter can be applied over the spur, and thus give passage to the fæces at a distance from the abdominal opening.

M. Jobert thinks the enterotrite should only be used for the purpose of securing adhesions. After forty-eight hours, by which time the adhesions have taken place, the instrument should be withdrawn, and when, in the course of a day or two, the adhesions have become more organized, the partition may be cut off with a pair of scissors without disturbing them.

Cauterization.—M. Vidal proposes to use caustics in place of the enterotrite. Each end of the forceps should contain a small hollow space which can be charged with the nitrate of silver, or, what is better, the Vienna paste. In this way the caustic cannot spread far; its action can be limited, and, at the same time, rapid, and nothing remains in the wound after the operation. The slough is gradually thrown off, and the ulceration left behind allows of the passage of fecal matter.

OBLITERATION OF THE EXTERNAL OPENING IN CASES OF ARTIFICIAL ANUS.

The spur or partition being destroyed, and a free communication between the two ends of the bowel having been established, the opening in the abdominal wall must be next obliterated. This obliteration is very difficult to accomplish.

Autoplastie has been tried by many surgeons, but without success. M. Velpeau practised excision, followed by sutures, upon a patient in 1835.

He thus describes the operation: " I included all the fistula in an ellipsis, with the view of excising it by a double half-moon-shaped incision, and so as not to interfere with the bowel, or, at least, its mucous membrane. I then put in four stitches, about two lines from each other, at the same time taking care that the middle portion of them did not reach as far as the cavity of the abdomen or the bowel. In the next place an incision, about two inches in length, and extending through the skin, the subcutaneous cellular tissue, and the aponeurosis of the external oblique, was made on each interrupt this continuity and to carry back the valves in a contrary direction. Hence the following operation, which M. Malgaigne has already successfully performed on the living subject.

The operator begins by paring the abnormal channel throughout its whole extent as far as the bowel, carefully separating the latter from its external adhesions, and remembering that these adhesions are very slight, and that by dividing them beyond a ⅓ of an inch in extent there would be the risk of opening the peritoneum. He then, without paring them, turns the two edges of the bowel inwards, and unites them by suture, so as to bring them together by their external surface. In addition to this suture he closes up the soft parts of the skin with the twisted or quilled suture, at the same time taking great care to avoid any forcible traction of the parts. If he meets with a loss of substance he would have recourse to autoplastie. In short, the essential point consists in isolating the bowel, to fold inwards its two edges or lips, and to close the external wound over it.

PLATE LXVIII.

OPERATION FOR ARTIFICIAL ANUS.

ANATOMY.

Fig. 1.—The anterior abdominal wall and the bulk of the small intestine have been removed; the large intestine has been preserved, in order to show the disposition of the different parts of the colon: *a*, transverse colon; *b*, ascending colon; *c*, cæcum; *d*, descending colon.

Fig. 2.—*The back of the body.*—The posterior abdominal wall has been removed: *f*, *f*, the vertebral column; *a*, the left kidney, covered by a layer of aponeurotic fascia; *b*, the arteries coming out of the lumbar vertebræ. A portion of the peritoneum being removed, the small intestines, *c*, are exposed; *d*, right kidney; *e*, right colon.

This figure shows the general disposition of the viscera in the lumbar region.

PLATE LXIX.

OPERATION FOR ARTIFICIAL ANUS.

Fig. 1.—*The operation performed on the cæcum, according to the plan adopted by Littre.*—*a, a,* dotted line showing the course of the ascending colon and of the cæcum ; *b, b,* incision made into the right iliac fossa through the abdominal wall ; *c, c,* blunt hooks separating the edges of the wound, at the bottom of which is seen the cæcum, *d.*

Fig. 2.—*Callisen's method—Amussat's operation.*—*a, a,* dotted line showing the course of the left colon ; *b, b,* transverse incision of the subcutaneous layers ; *c, c,* hooks separating the lips of the wound ; *d, d,* coils of thread passed into the extra-peritoneal portion of the left colon.

Fig. 3 & 4.—Junction of the edges of the wound in the bowel to the edges of the abdominal wound by means of sutures.

3. Imperforate rectum, or an absence of a portion of the bowel, and when a passage cannot be established lower down.

Two methods of operating are practised at the present day. The first is that of Littre, who, having noticed an imperforate rectum in an infant that died at the age of six days, conceived the possibility of establishing an artificial anus by an opening through the abdominal wall and the sigmoid flexure of the colon. The second method was proposed by Callisen, of Copenhagen, and consists in opening the ascending colon in the right lumbar region.

Littre's operation (Plate LXIX.).—The instruments required are: an ordinary scalpel, a director, forceps, scissors, needles, and wire sutures. The infant being placed upon his back, and brought under the influence of chloroform, an incision about two inches long, and starting from midway between the umbilicus and the anterior superior spine of the ilium, is continued down the left flank toward's Poupart's ligament. The various layers of the abdominal wall are divided on a director ; and on the peritoneum being opened, the sigmoid flexure is readily found, being recognized by its thick and knotted appearance. This piece of the bowel is then brought up to the wound, opened longitudinally, and the edges fixed to the wound in the abdomen by wire sutures. Plastic effusion, should the child survive, will quickly cause the edges of the gut to become adherent to the lips of the wound. The best dressing will consist in oiled lint.

Mr. Edmund Owen, who has lately had a successful case of this nature, is of opinion that, for imperforate rectum where no anus can be established after careful dissection in the perineum, the colon should be at once opened from the left flank; and, further, that on account of the large intestines in the infant being very tortuous, and floating in a mesentery, the surgeon should never attempt the extra-peritoneal (Amussat's) operation. At the same time, or on a future occasion, a flexible gum-elastic catheter might be passed through the lower piece of the large intestine towards the perineum. With this aid, Mr. Owen believes the blind end of the bowel might be discovered from the incision in the perineum, and there be opened and secured.

Callisen's operation (fig. 2).—To avoid injuring the peritoneum, a result inseparable from Littre's operation, Callisen proposed opening the descending colon in the loins, between the last rib and the crest of the ilium. In this part of its course the left colon can be reached without wounding the peritoneum (at least in the adult). But Callisen's proposal did not meet with a favourable reception at the hands of contemporary surgeons.

In 1830 Amussat was occupied with the study of Callisen's proposal, and framed the rule for the operation which we now describe.

Amussat's operation.—Anatomy.—The relationship existing between the peritoneum and the lumbar colon must be well understood. If this piece of the gut is examined on its posterior aspect, after the removal of the mass of muscles which covers it, it is seen that the posterior third is uncovered by the peritoneum. This posterior part of the intestine rests upon the

The operation.—The patient must be placed with his face downwards, and the body rolled somewhat on to the right side. It is generally advised that a pillow be placed under the right side; but, as is pointed out by Mr. James Lane, such an arrangement tends to push the coils of small intestines over to the neighbourhood of the left colon. An incision, three or four inches in length, is then made horizontally, outwards, from the outer border of the erector spinæ, midway between the last rib and the iliac crest. (It might be necessary, in a very fat subject, to make the incision in the skin cruciform.) Beneath the skin and fat the outer border of the latissimus dorsis is seen at the spinal end of the wound. This must be divided, as must also the posterior part of the external oblique, which lies at the anterior extremity of the wound. Afterwards the internal oblique, the transversalis, and the transversalis fascia are divided, layer by layer. The last-named structure may be divided more vertically than the others.

Beneath these layers lies the colon, which is somewhat masked by layers of connective tissue and fat that must be manipulated with great care. The difficult part of the operation consists in recognizing and properly opening the gut. Before incising the gut it is well to lay bare the two sides without using any roughness. On the dead subject the colon is more readily recognized by its colour than it is in the living; the colour is due to the presence of fecal matter. The thick and "resisting" feel of the large intestine is a useful help. Should the intestine be contracted it will be found further back upon the quadratus lumborum, which muscle must be notched, if, indeed, it have not been so treated already. The bowel should not be opened without due consideration. On the contrary, it is well to give it time to become inflated and bulge out of the external wound.

The colon being recognized, two strong sutures, distant about an inch, are passed through its walls and are given to an assistant. It is then opened by the scalpel, and an escape of ill-smelling gas and liquid follows. The opening thus made may be increased to any extent desirable by a blunt-pointed bistoury. A free escape of pent-up material then takes place.

If thought advisable, an injection of warm water, above and below, through the wound, will do much to clear the canal. When further escape of fæces seems unlikely, the wound in the bowel is fixed to that in the skin by twisted wire sutures (figs. 3 & 4). The ends of the wound may also be closed, and joined to the intestine by carefully arranged sutures.

Having twice performed this operation, M. Malgaigne does not consider it necessary to divide the muscular layers by a cruciform incision, as the fibres contract so as to expose the bottom of the wound.

Relative merits.—Callisen's operation has a real advantage over that of Littre, in that it exposes the peritoneum to less interference, whilst the artificial anus placed behind is, in certain circumstances, less in the way than the anus in the front of the abomen.

PLATE LXX.

OPERATIVE SURGERY OF THE ANUS AND RECTUM.

All the figures in this plate represent the rectum in vertical section, and the course of a fistula.

Fig. 1.—*Blind internal fistula*—*a*, *b*, fistula; *a*, internal orifice communicating with the interior of the bowel, ***d***; ***b***, blind end of the fistula; *c*, anus; *f*, section of tissues between the fistula and the bowel.

Fig. 2.—*Complete simple fistula.*—*a*, *b′*, *b*, fistulous tract opening at *a*, in the intestine, *d*, and at *b*, near the anus ***c***; ***f***, section of intervening tissues.

Fig. 3.—*Blind external fistula.*—*a*, external orifice of fistula; *b*, fistula and off-shoots; *d*, intestine; *c*, anus.

Figs. 4 & 6.—*Incision.*—*Ordinary method.*

Fig. 4—*First step of the operation.*—*c*, a grooved director is passed through the fistula, *a*, *b*; the index finger, *d*, of the operator catches the end of the instrument in the intestine at the inner end of the fistula to hook it outside the anus.

Fig. 6—*Second step of the operation.*—*Incision.*—The end of the director, *g*, has been brought out; *a*, *b*, the fistula; ***e***, the blade of the bistoury lodged in the groove of the director, *g*, *d*; this blade travelling along the director will divide the bridge of tissues, *f*.

Fig. 5 & 8.—*Desault's method.*

Fig. 5.—A grooved director, *a*, *c*, *b*, passed through the fistula is caught by an instrument, *d*, introduced into the intestine. A bistoury, *e*, is started in the groove of the director to divide the bridge of tissues, *f*.

Fig. 8.—*The same operation.*—The bistoury, *e*, meets the instrument, *d′*. These two instruments will be drawn out together to divide the soft parts in the angle made by the instruments. *c′*, the grooved director.

Fig. 7.—*Ligature.*—A thread of silk introduced into the fistula, *b*, *a*, reaches the intestine, *d*, and passing out by the anus, includes in a loop, *c*, *a*, *c′*, the organic bridle, *f*.

FISTULA IN ANO.—OPERATIONS.

Fistula in ano is of several varieties; some *complete* (fig. 2), consisting of a course communicating with the intestine by an *internal orifice*, and in the neighbourhood of the anus by an *external orifice*. The others, *incomplete* or *blind*, have but one opening, their other end being a *cul-de-sac*. The *blind external* fistula has an opening on the exterior only, the track does not communicate with the bowel. The *blind internal* fistula opens into the rectum, but not on to the exterior. Fistulæ are said to be *complicated* when their course branches off into sinuses, and they are often accompanied by much induration of the surrounding tissues. Such complications may require modifications in the operation; but the chief point to be borne in mind is to hunt out and open up all offshoots, and to freely incise indurated walls.

To learn the nature and extent of a fistula, it is necessary to explore with a blunt-pointed flexible probe introduced by one of the openings, and it is only after careful examination in this way—occasionally once or twice repeated—that a true the external orifice, *b*, passes along the fistula, and impinges by the opening, *a*, on the pulp of the finger, *d*. Important evidence of the presence of a fistula in ano is the thicking about the anus—a thicking due to chronic inflammatory deposit; before searching for an opening it is well to feel carefully around the anus for the hard and rigid course of the burrow. From the time of Hippocrates practisers of the healing art have endeavoured to cure fistulæ in ano by cauterization and by injection of caustic or irritant fluids; but such methods generally end in failure and disappointment—occasionally in inflammation and hæmorrhage.

Ligature.—For surgeons or patients who have an antipathy to the knife in the treatment of fistulæ in ano, a ligature of silk, wire, or hemp has suggested itself. This method of treatment is unattended by loss of blood, which in some cases may be a matter of importance, and in uncomplicated cases may be successful; but where there are branching sinuses and much induration of the parts nothing short of free incision should be attempted. For ligature with wire a small canula is first introduced by the fistula, and the wire is passed through it into the rectum and drawn out through the anus; the canula is then withdrawn and the knot tied. Five or six weeks may be required for the ligature to cut its way out. Much pain is experienced on the knot being from time to time tightened up, and, perhaps, after all, the surgeon is forced to complete the tedious cure by the bistoury. Free incision is evidently to be preferred to such half measures.

Incision.—A purgative should be administered on the evening before the day of operation, and an enema should be administered in the morning, so that there may be but a small chance of evacuation taking place upon the operating-table, and that there may be no need for the bowels being disturbed for some days subsequently. The instruments that will be required will be probes, a grooved steel director, a scalpel, curved bistoury, straight blunt-pointed bistoury, a pair of spring scissors to cut off angles of thickened tissue, and cotton wool for the after dressing.

The patient should be placed upon the affected side, and the upper thigh, flexed upon the abdomen, should be fixed by an assistant. The same assistant should with the other hand drag up the fold of the buttock. Another assistant should take charge of the lower leg, whilst a third steadies the affected buttock and looks after instruments.

Ordinary method (Fig. 4 & 6).—The grooved steel director having been introduced through the fistula, and having been caught by the pulp of the index finger introduced into the rectum (fig. 4), is thus hooked down out of the anus, and the end is drawn out over the opposite buttock (fig. 6). The curved bistoury travelling down the groove effects the section of the intervening tissues.

The straight bistoury will be then found of great use in dividing hard and thickened bands and tissues generally.

Fig. 5 & 8 show Desault's method of operating on fistulæ, which open high up into the rectum; but with a finger of average length such modifications as he suggests are quite superfluous; the secret of success in all operations for fistula lying in free and thorough divisions of sphincter, sinuses, and painful, but the fourth or fifth creates much less trouble. M. Vidal (de Cassis) speaks highly of tents prepared with mercurial ointment and belladonna.

It has been advised to commence the gradual dilatation with full-sized tents, so that the painful treatment may be rendered as short as possible, the sphincter being quickly and thoroughly stretched. The tent may be left in a day or two ; and after its removal an enema may be given. Dilatation may be associated with cauterization.

M. Récamier's treatment.—In 1838 Récamier showed the possibility of curing fissures by *extension* and *dilatation.*

The patient having been placed upon his side, and brought to the edge of the bed, the legs are flexed upon the thighs and the thighs upon the trunk. The surgeon's right index and middle fingers, having been smeared with ointment, are introduced into the anus, first the index, then the middle finger, and by this means the anus is well and steadily dilated. The pain is acute, but of short duration, and Récamier did not find it necessary to administer a narcotic. To make the dilatation more complete, Récamier used often to introduce the left index finger as well as the two mentioned (*Journal des Connaissances Médico-Chirurgicales,* 1852). This gradual dilatation is unattended by danger, and is certainly to be preferred to M. Velpeau's method of *excision.* Indeed, twice in six cases did this excision fail in M. Velpeau's hands.

Boyer's method of *division of the sphincter* is applicable to all fissures which do not get well under other treatment : by its means all spasm and pain cease, and the fissure granulates to the surface.

The patient having been prepared for the operation (as for the operation for fistula), is brought to the edge of the bed, and a straight bistoury with a blunt end is laid flat upon the left index finger and introduced into the rectum. The edge is then turned towards the fissure, and the sphincter incised as the knife is withdrawn. A pyramidal wound results, the apex being above, the base at the anus. It is well to let the incision through the fissure be free. A light dressing of cotton wool is applied to the wound ; the bowels are kept from acting for three days; and at the end of five or six weeks all is soundly healed.

Slight but painful ulcers, hidden beneath the anal folds, may be cured by drawing the edge of the knife gently down their course, without dividing the sphincter.

Other methods of treatment have from time to time been introduced, but as ordinary fissure—we do not speak of syphilitic fisssure, which, of course, requires no operation—can be cured by dilatation or by division of the sphincter, it is quite unnecessary to describe them.

PLATE LXXI.

CONTINUATION OF OPERATIONS UPON THE RECTUM AND ANUS.

Fig. 1.—*Removal of piles.*—The piles are held by ligatures at *a* and *b*, and are removed by scissors, *c*, curved on the flat; an ordinary vulsellum will act as well as, or better than, a ligature in holding the tumour.

excision. But strong nitric acid may be applied with advantage to a general and relaxed condition of the mucous lining of the rectum.

Treatment by ligature.—For this process the tumour must be drawn well out of the rectum by a vulsellum, and there held by an assistant. The blade of strong scissors, passed up between the broad root of the pile and the wall of the rectum on the side to which it is attached, incises the mucous membrane, and diminishes the amount of tissue to be inclosed in the ligature. As the hæmorrhoidal vessels pass vertically downwards into the pile, there is but little or no danger of their being divided in the cut. The ends of the ligatures, which should be of strong hemp, well waxed, are left out of the rectum. The tumours slough off in about ten days. Should the mass of prolapsed membrane appear as a large pad extending in a circular manner around the bowel, it will be necessary to tie it in separate portions. Before tying the ligature the pile must be drawn well out and away from the wall of the rectum, and by the aid of the tips of the index fingers the noose must be pushed high up round the pedicle. No dressing other than by cotton wool will be required. An opium suppository may be administered at the end of the operation if it is thought desirable. Action of the bowels should be prevented for three or four days lest hæmorrhage should occur.

Mr. Henry Smith has identified himself with the treatment of internal piles by the clamp and the actual cautery. An incision is made as for ligation, the clamp is applied, and the tissue cut off to a level with the clamp; actual cautery is then applied to the stump.

External piles, which are small knots of varicose vein, often with effused blood in hardened skin, may be cut off with curved scissors, and the small wounds dressed with cotton-wool.

M. Velpeau has advised that, after excision of a pile, the edges of the wound should be brought together by suture.

VENEREAL EXCRESCENCES.

Condylomata are distinguished from piles by their flat and button-like appearance, by their being covered with moisture, and by their presence on the scrotum, as well as around the anus. They generally disappear under proper constitutional treatment.

POLYPI OF RECTUM.

Polypi are treated as internal or external piles, according to their situation.

CANCER OF RECTUM—ANATOMY.

The following data have been given by Lisfranc: The antero-posterior diameter of the female perineum is rather more than an inch; in both sexes the distance from the anus to the tip of the coccyx is rather more than an inch and a half.

In the female the front of the rectum lies in close proximity to the vagina, and higher up it is separated from the uterus by a *cul-de-sac* of peritoneum. This *cul-de-sac* also comes down between the vagina and the rectum. Posteriorly the rectum lies upon the sacrum, and having reached the tip of there fixed by assistants. One of these assistants stretches the integument around the anus, whilst the other hands the instruments to the surgeon, who makes, with a sharp bistoury, two bold semicircular sweeps around the anus. The incisions meet in front of and behind the anus. If malignant growths or ulcerations are found in the integument the incisions must be kept well to their outside. The skin is then freely dissected up by directing the bistoury towards the rectum. The left index finger is then introduced into the bowel, and the whole mass is drawn firmly down through the wound. When the malignant disease is limited to the mucous membrane, and at the same time does not extend far up the bowel, the wall of the rectum may be turned almost inside out, and the morbid growth shaved off or removed by curved scissors.

2nd. But where, as is too often the case, the disease has spread for some inches up the bowel, and has invaded the external coat, the operation just described would be of no use ; a more complicated one is required. The first part of the operation must be performed as before, and, in addition, the fibrous tissue around the rectum must be divided by a strong pair of scissors directed up into the pelvis parallel to the axis of the rectum. This incision must be kept as much as possible to the back of the bowel, so that the peritoneum which slopes downwards and forwards into the sides of the bladder may not be wounded. The incision must, however, pass well beyond the limits of the disease. The bleeding may be checked by pausing for a few moments, and stuffing the wound with sponges soaked in ice-cold water. After this, one can obtain a good idea of the extent of the disease, and Lisfranc assures us the wound does not give out more blood than if it were upon the dead subject. The lower end of the rectum can be drawn well out of the wound, and there held by a strong vulsellum.

When the operation is to be performed upon a female, the fingers of an assistant should be introduced into the vagina to push down the vecto-vaginal wall; and in this region the dissection must be conducted with the greatest delicacy. If the subject be a male, a staff should be passed into the bladder to demonstrate the course of the urethra, and to save it from injury when the front of the rectum is being dissected. The assistant who holds this staff should warn the operator each time the bistoury comes near it. And from time to time the surgeon himself should take hold of the staff to reassure himself of the relations of the parts.

After the diseased part has been removed, a careful exploration by means of the finger will be necessary. A large drainage tube may be left in the rectum. With women it may be necessary to draw off the urine, so that the wound may not be irritated during micturition.

Velpeau's operation.—When the stricture lies within easy reach of the finger, M. Velpeau recommends that it be divided posteriorly, and that the mass be treated by ligature, like an internal pile. (See page 321).

Remarks.—M. Vidal has collected statistics of this operation which give reflections that must not be lightly passed over.

"The operation can rarely remove all the disease; then it will do harm and hasten death. Out of nine cases Lisfranc with the scirrhus. In the female the operation should never be attempted when the finger introduced into the vagina finds the partition invaded.

PLUGGING THE RECTUM.

Severe hæmorrhage, after operations such as we have just described, may render this process necessary. A *cul-de-sac* of strong linen may be introduced into the rectum by the finger, and then packed tightly with small pieces of sponge or of dry lint.

FOREIGN BODIES IN THE RECTUM.

Much will depend upon the nature of the material introduced as to what process be adopted. If the body be angular the mucous membrane must be well protected by the finger, and pressed out of the way, as the material is withdrawn. Or a speculum may be inserted, and the body withdrawn through it. Section of the sphincter might be necessary.

STRICTURE OF THE ANUS AND RECTUM.

This affection may be dealt with by dilatation or by incision.

Dilatation.—Desault dilated the rectum with greased tents, gradually increasing the size. Gum-elastic bougies might be employed in the same conditions.

M. Costollat introduced a small linen bag by the aid of a bougie, and then stuffed it with cotton-wool. But the best means of dilatation is afforded by Todd's double-bladed dilator. A thin capsule of india-rubber covers the blades, which are gradually separated by a screw. The india-rubber cap prevents the mucous membrane being injured when the blades are approximated previous to the withdrawal of the instrument from the rectum.

Incision is specially applicable to fibrous stricture where no malignant disease exists. It is effected by a long blunt-ended bistoury introduced flat on the finger. When the stricture has been entered and passed, the edge is turned to the stricture, and the incision is performed as the instrument is withdrawn. The nicks into the stricture should be made at the back and sides of the bowel, as the vagina, or bladder, lies close to the front. Dilatation may afterwards be indicated.

PROLAPSE OF THE RECTUM.

Sometimes the mucous membrane, but loosely connected to the other tunics of the rectum, descends externally for an inch or so. Sometimes the prolapsed part consists of the whole thickness of the bowel with some peritoneum.

For the cure of this condition several operations have obtained,—reduction, excision, cauterization, and excision of folds at the anus. In children no active treatment of the bowel itself is required, as the prolapse is probably due to calculus, worms, phimosis, or to some disturbing element. The child so affected should never be allowed to pass his motions *sitting*. Should the prolapse be due to a general feeble condition, all that will be required is reduction, and an occasional astringent enema ; the affection will disappear with the return of health. The rectal tumour should be washed and then oiled. Gentle compression with the of meconium escapes. A crucial incision is then made in the septum, and the corners are cut off by scissors. Pieces of oiled lint are then inserted, and are kept there until cicatrization has advanced (Plate LXXI., fig. 3).

Should the septum exist higher up, it may not be possible to reach it satisfactorily with the knife. Should it be beyond reach, an artificial anus must be made. This high imperforation may be diagnosed by the absence of evacuation of meconium, by the general symptoms and discomfort of the unhappy infant, and by constant efforts at vomiting. The confirmation is obtained by a flexible bougie introduced into the rectum, meeting the obstruction.

Should the septum be within reach, the treatment by the guarded scalpel and by dilatation is indicated and is easily performed. Meconium at once escapes, A piece of oiled lint may then be passed through the opening.

Malgaigne gained easier access to the partition by dividing the sphincters of the anus.

In a case under the care of Mr. A. T. Norton the anus was formed; but a septum *more than an inch* in thickness existed between the anus and the bowel. A fine trocar and canula was cautiously introduced, with an aspirator attached. As soon as the bowel was reached a small quantity of meconium was at once aspirated from the canula, and a sharp-pointed straight bistoury was then carried along the canula, to enlarge the opening to a sufficient extent by means of a crucial incision.

ABNORMAL ANUS.

The inferior extremity of the rectum may be wanting, and the bowel may open into the bladder, urethra, or may end in any part of the pelvis. When the rectum opens into the vagina, two methods of treatment have been proposed. The first is the division of the perineum and the partition up to the abnormal anus. A tube is placed in the bottom of the wound, and the edges united in front of the tube, so that the tube continues the course of the bowel. The other operation consists in puncturing the bowel from the proper site of the anus, and treating the abnormal anus like a recto-vaginal fistula. Should there be absence of the lower end of the rectum, a dissection may be attempted from the perineum with the view of finding the blind end. Should this process fail, an artificial anus would be necessitated, and would be performed as described a few pages back. Generally the rectum ends in a *cul-de-sac*, filled with meconium. The knife must be directed towards this pouch from the perineum, layer by layer. Should the operator be fortunate enough to meet with the pouch, the treatment is simple enough.

Should the rectum open into the bladder one will operate as for imperforate rectum, directing the knife in the dissection well up the front of the sacrum, so as to avoid injuring the bladder, or, in the female, the vagina.

PLATE LXXII.

OPERATIONS PERFORMED UPON THE PENIS.

Fig. 1.—Division of the frænum.—A bistoury, *a*, transfixes

Division of the Frænum (Fig. 1).

The operation may be performed with the scissors or bistoury. An assistant holds the glans; the operator pulls forward the fold of skin containing the band. A snip of the scissors, or a stroke of the bistoury which has transfixed the frænum, completes the operation. The best dressing is a small piece of dry lint.

Phimosis (figs. 2 to 5, *bis*).

Phimosis may be operated on by incision, excision, or circumcision.

1. *Incision.*—Incision consists in setting free the prepuce. M. Cloquet advises that the incision be made at the lowest part; but here lies the artery of the frænum, the division of which may give rise to troublesome hæmorrhage. The prepuce is best incised above, and from behind forwards, a grooved director having first been introduced (fig. 2) between the foreskin and the glans. It is well to have the skin made tense during the cutting part of the operation.

2. *Excision.*—Excision often follows as the second step, after incision, for when two long flaps hang down on either side of the cut, it is necessary to snip off their corners, as is shown in fig. 3. The flaps may be removed by scissors or by knife.

3. *Circumcision.*—In this operation the whole free end of the prepuce is taken away. The prepuce is drawn forwards, and all the redundant skin is caught between the blades of forceps, as shown in fig. 4. Fig. 4, *bis*, shows the section with the bistoury, and fig. 5 the relation of mucous membrane and integument after section. It will be necessary to excise the mucous membrane, as it is sure to be less affected by the section than the skin. The glans must be completely uncovered after the operation, the mucous membrane being turned well back, and, when adherent, peeled from off the glans.

It is advisable that sutures be introduced to keep the edges of the skin and mucous membrane in apposition, so that the process of cicatrization may be accelerated.

PARAPHIMOSIS (Fig. 6).

For paraphimosis reduction by careful compression should be attempted. Should this fail, it may be necessary to divide the constricting band, which is usually found at some distance behind the œdematous prepuce.

1. *Reduction.*—The operator seizes the penis, as is shown in fig. 6. With his thumbs he pushes back the glans, which has been previously smeared with oil, whilst with the index and middle fingers of each hand he drags forward the œdematous prepuce.

Compression exercised by a narrow bandage may succeed, after several hours, in restoring the parts to their proper condition when the ordinary method proves inefficient. In troublesome cases, punctures to allow of the escape of the serum will aid in the reduction.

2. *Section.*—When the parts are much inflamed, and the pad of mucous membrane is much strangulated, it may be necessary to divide the constricting band.

The surgeon seizes the penis in the left hand, placing the

PLATE LXXIII.

OPERATIONS UPON THE PENIS AND SCROTUM.

Fig. 1.—*Operation for hydrocele.*—The operator takes the tumour in the left hand, *a*, and punctures with a canula and trocar held in the right hand (fig. 1 *bis*).

Fig. 2.—*Operation for sarcocele.*—Ligature and excision of the arteries of the cord. The cord is laid bare by an incision along its course; the spermatic artery is separated by a director, *a*, from the other constituents of the cord.

Fig. 3.—Dissection of the tumour with a bistoury, *a*.

Fig. 4.—*Amputation of the penis.*—The surgeon holds with one hand, *a*, the extremity of the penis wrapped in a piece of lint; an assistant, *b*, holds back the integument at the root; *c*, the knife amputating the organ.

HYDROCELE (Fig. 1 & 1 *bis*).

Tumours composed of a collection of serum are called hydroceles. When it collects in a sac such as the tunica vaginalis, it constitutes an ordinary hydrocele. Œdema of the scrotum is often due to general causes, and may be relieved by punctures. *Hydrocele* may occupy the tunica vaginalis or the spermatic cord. A *congenital* hydrocele is one in which the fluid collects in the tunica vaginalis, and filling the funicular process of peritoneum, passes up into the general peritoneal cavity. In such a case the scrotal tumour can be emptied into the abdomen; at any rate, the swelling diminishes when the patient lies on his back, and has his pelvis raised. The constant pressure of a truss is generally sufficient to effect a cure; no operation should be undertaken. Hydrocele of the cord may be treated as a hydrocele of the tunica vaginalis; but the surgeon, remembering the close proximity of the structures of the cord, and of the peritoneal cavity, should be cautious in the employment of injections. The treatment of hydrocele may be palliative or radical. The former consists in drawing off the fluid by puncture. But after this simple operation the fluid may collect again and the affection return. For the radical cure the nature of the secreting surface of the serous membrane must be altered so as to prevent the recurrence of the affection. To obtain this condition recourse has been had to puncture, incision, excision, cauterization, seton, suture, and injection.

Puncture is best performed by a small canular trocar. The patient lying down, the scrotum is taken in the palm of the left hand, and so held as to render tense the integument, and the front and lower part of the tumour should project between the thumb and index finger. Having first made out the exact situation of the testis, by the aid of a strong light, the instrument is suddenly plunged into the fluid, the depth of the puncture being limited by the right index finger, which is held firmly against the canula. The trocar is then withdrawn and the canula held in position, whilst the serum flows away.

Incision.—The scrotum is held as for puncture (*vid. sup.*), and the tissues are divided layer by layer down to the tunica vaginalis; an incision through this structure is made of sufficient length to allow the cavity to be stuffed with oiled lint cord and in the loins. The fluid can be then pressed out through the canula.

As the injection is being performed, it is very necessary that the end of the canula be free in the sac, lest some of the fluid be thrown up amongst the tissues of the scrotum. Should such a mishap occur, free incisions must be made for the escape of the irritating fluid, lest gangrene supervene.

After the use of the seton, or of the injection, the parts become very red and inflamed, hard and painful; then absorption commences, and at the end of a fortnight the patient is probably cured. Should suppuration follow, the certainty of cure becomes absolute.

TUMOURS OF THE TESTIS (figs. 2 & 3).

Malignant tumours of the scrotum may be treated by ligature of the spermatic vessels, or by castration.

1. *Ligature* (fig. 2).—The cord is laid bare by a free incision along its course, the vessels are raised, tied in two places, and are divided between the two ligatures.

Preferable to such interference is castration.

2. *Castration* (fig. 3).—The first step consists in laying bare the cord; the second in its division, and in the removal of the gland itself.

First step.—An incision is made down the front of the cord from the external abdominal ring; and when the gland is not adherent to the integument, it can be easily turned out by the handle of the scalpel and by the finger. But if it is adherent a careful process of dissection may be required. All the diseased skin must be removed.

Second step.—The tumour forced from its coverings, and now only attached by the spermatic cord, is supported by an assistant. The cord may be divided by a single cut, and the arteries may be secured when the testicle is taken away. But, perhaps, it is preferable to tie the cord in one ligature before dividing it, as all risk and trouble of hæmorrhage is then at an end. Moreover, there will be no danger of any divided arteries being drawn, by the elastic cord, up into the abdomen and bleeding there.

AMPUTATION OF THE PENIS.

When cancer has spread into the depths of the penis nothing short of amputation will be of use. The penis is held at the root by an assistant, and the surgeon, drawing it well forward, severs it with one sweep. It must be remembered that the corpora cavernosa retract more than the skin. The assistant must not pull too much upon the skin lest such redundance at the end result that the aperture becomes interfered with. As the corpus cavernosum contracts in proportion to its length the nearer the amputation is performed to the scrotum the more skin may be left.

After the amputation a catheter is fixed in the urethra, and though it is removed from time to time, still its use must be continued until cicatrization is complete.

PLATE LXXIV.

OPERATION FOR VARICOCELE.

Fig. 6.—The varicose veins, *a*, *a*, are strangled between the two wires, *b* and *c*. The vas deferens, *d*, is to the outside of the veins.

Fig. 7.—The veins puckered up by the twisting of the wires.

Fig. 8.—The wires slightly twisted.

VARICOCELE.

Varicocele may be radically treated by compression, twisting, or ligature.

1. *Compression.*—*Breschet's method* (fig. 1).—This method consists in compressing the varicose veins by the blades of forceps, which nip the included tissues, and are fixed by screws. A slow section of the veins results from the pressure. Before applying the blades the veins should be well distended by a hot bath. The vas deferens and the artery should be carefully separated from the varicose veins, so as to escape strangulation. The former structure can be recognized by its whipcord-like feel. All the veins should be compressed. The blades have been modified by M. Landouzy, so that the border of the fold of skin is not damaged.

2. *Suture.*—*Velpeau's method* (fig. 2) may be performed in two ways: by passing a pin under the veins, and twisting a ligature tightly around in figure of 8; or the veins may be compressed by two pins placed, one in front and one behind the cluster, the ends of the pins being firmly secured by ligatures.

Ligature.—By a curved needle a strong ligature is passed through the scrotum, around the veins, and out near to the point of entrance. The two ends are then tied tightly around a roll of lint, so that the skin suffers but little. In about a fortnight the vessels are divided. Or the two ends may be brought out of the same opening, and the veins tied subcutaneously.

Ricord's method (fig. 3, 4, & 4 *bis*).—The varicose veins are isolated in a fold of scrotum, and a loop is passed behind them through the scrotum (fig. 3, *a*). Another loop is passed through the same holes in front of the cord, but in the opposite direction to the first loop, so that the cord lies, *a* (fig. 4), between two double ligatures. Then, as represented in fig. 4, the ends are passed through the loops, and on drawing them tightly in opposite directions (fig. 4 *bis*), the vessels are thoroughly strangulated. The free ends may be tied to the extremities of a piece of metal of horse-shoe shape.

M. Vidal (1844) twists up the veins (figs. 5, 6, 7, & 8), passing a needle, *a* (fig. 5), armed with a wire, *b*, between the veins and the vas deferens, and then another, *a′*, with a finer wire, *b′*, in front. The same openings serve for the two wires. By bending the first wire with the concavity slightly forward, the finer wire lies like a bow-string in front of the veins.

Fig. 6 shows the varicose veins, *a, a;* the testicle and vas deferens, *d;* the latter being kept out of the way. The wires, *b* and *c*, include the veins. On twisting the wires round and round the veins are entangled and wound up also (fig. 7): the vas deferens is not interfered with.

As the veins have a fixed point above (in the abdomen), and are movable below, the act of winding causes the testis to ascend towards the inguinal canal.

Fig. 8 shows the wires slightly twisted, with the thinner

PLATE LXXV.

OPERATIONS ON THE BLADDER AND URETHRA.

Fig. 1.—*Supra-pubic puncture of the bladder.*—This diagram gives a vertical section of pelvis, and shows the relations of bladder to neighbouring viscera. *a*, meatus urinarius; *b*, neck of bladder; *c*. interior of bladder; *d*. symphysis pubis; *e*, connective tissue between pubes and prostate; *f*, section of bulb; *g*, septum scroti; *h*, prostate; *i*, rectum; *k*, deflection of peritoneum from summit of bladder on to abdominal wall; *l*, trocar and canula passing over pubes into bladder.

Fig. 2.—*Perineal puncture of bladder.*—The body is placed in the lithotomy position; *a*, spot at which puncture is performed between the anus and front of ischial tuberosity; *b*, projection of bulb beneath the skin; *c*, anus.

Fig. 3.—*Puncture through the rectum.*—The median section shows the relations between bladder and rectum. *a*, bulb in median section; *b*, posterior lobe of prostate; *c*. interior of bladder; *d*. summit of bladder; *e*, symphysis; *f*, left index finger of operator introduced intor ectum to guide the instrument in effecting puncture through base of bladder.

PUNCTURE OF BLADDER.

Now that the treatment of stricture is better understood, the operation of puncture of the bladder is becoming a rare operation, and is only had recourse to when every other means of relieving the retention has failed. The aspirator is now used in preference to the trocar. Let the operator be absolutely sure of the need of this operation before he performs it. Much may be learnt from the introduction of the finger into the rectum. When the performance of the operation becomes imperative, delay may be attended by rupture of the viscus.

1. *Supra-pubic puncture* (fig. 1).—When the bladder is much distended it rises nearly to the umbilicus, carrying the peritoneum up in front of it; the anterior surface—base of serous covering—lies close behind the front of the abdomen.

To perform this operation the patient must be brought to the edge of the bed, and his head and shoulders raised; the canula and trocar are then forced with a sharp and sudden plunge down into the interior of the bladder, the point entering the abdomen in the middle line and close above the pubes, *b*. It is advisable to puncture the skin with a knife before thrusting in the trocar. The canula is then steadied, and the trocar withdrawn. When the urine is withdrawn, the end of the canula is fixed to tapes passing around the pelvis and thighs, and a small plug of wood stops up the opening of the instrument. If the instrument is too long, and the end be not guarded during the puncture, the posterior wall of the bladder might possibly be wounded; but if the instrument is too short the bladder will slip away from the end as it contracts. When the distress is relieved the stricture becomes less obstinate, and allows the passage of a catheter; but until this happy result is brought about the canula must be kept in the bladder.

2. *Puncture by the perineum* (fig. 2).—The patient is placed in the lithotomy position, and the straight canula and trocar is plunged into the bladder through a spot lying between the anus

vesical fold of peritoneum. When the bladder has been evacuated, the canula is fixed to a spika of tape; the urine may be allowed to pass, as quickly as it flows into the bladder, out by the canula into a carefully-arranged receptacle.

These situations have been chosen for tapping the bladder on account of their being free of important connections and on account of their being easy of access. The perineal puncture offers no special advantage. The rectal puncture has hitherto been most frequently performed; but should the prostate be much increased in size it may become necessary to have recourse to the supra-pubic puncture. But, as we have said above, the operation is now rarely required because the simple and frequent use of the aspirator gives all that can be desired, and is almost free from danger. The site for puncture by the aspirator needle is an inch or so above the symphysis pubis.

PLATE LXXVI.

CONTINUATION OF OPERATIONS UPON THE BLADDER AND URETHRA.

Fig. 1.—Vertical section shewing the direction of the urethra, and the position of pelvic viscera, etc. *a'*, neck of bladder; *b*, cavity of same; *c*, opening of ureter; *d*, summit of bladder; *a*, glans penis; *l*, corpora cavernosa; *e*, prostate; *f*, bulb; *g*, vesicula seminalis; *h*, front of prostate; *i*, symphysis; *k*, rectum.

Fig. 2.—*Catheterization.*—Introducing the instrument into the meatus urinarius, *a*; *b*, bladder; *c*, opening of ureter; *d*, summit of bladder, and, *a'*, neck; *e*, prostate; *f*, bulb; *h*, front of prostate; *i*, symphysis; *l*, floor of urethra.

Fig. 3.—*Catheter, reaching to the prostate.*—*a*, meatus; *b*, bladder; *c*, ureter; *d*, summit of bladder; *a'*, beak of catheter; *e*, prostate; *f*, bulb; *i*, symphysis; *l*, catheter in the spongy part of the urethra.

Fig. 4.—The catheter entering the bladder as the penis is depressed. *b*, beak of catheter in the bladder; *e*, *h*, prostate; *g*, vesicula seminalis; *k*, rectum.

SURGICAL ANATOMY OF THE URETHRA.

The urethra in the female is the conduit for the urine only, in the male it conveys also the semen.

The male urethra is divided into three parts for description. 1. The prostatic part, about an inch and a quarter in length, and extending from the neck of the bladder to the posterior layer of the triangular ligament. 2. The membranous part measures about ¾ inch in length, and, lying between the two layers of the triangular ligament, is curved, with its concavity directed to the under part of the symphysis pubis. This part is surrounded by the compressor urethræ. The bulb projecting backwards overlaps the floor of the membranous part of the urethra. 3. The spongy part of the urethra measures six or seven inches, but its length varies with the condition of the penis. It extends from the membranous part behind to the meatus urinarius in front. It must be borne in mind that the canal takes a bold sweep under the pubes to reach the neck of the an ordinary sized catheter can be introduced (Pl. LXXVII., fig. 9 *bis*).

Structure and relations.—The mucous membrane is thin and elastic, and darkens in colour towards the meatus; there it becomes continuous with the delicate covering of the glans penis. When the canal is distended the longitudinal folds which are found in the flaccid urethra become effaced.

In the prostatic urethra the mucous membrane and erectile tissue are raised in a permanent ridge called the veru montanum, and burrowing backwards beneath it is the depression known as the sinus pocularis. On either side of the ridge lies a groove, the prostatic sinus, which receives the openings of the prostatic follicles. Into the sinus pocularis open the two common ejaculatory ducts.

The lining of the urethra is studded with the small openings of the mucous crypts of Littre; these are apt to become the seat of abscess in connection with urethritis, and to open externally; much more rarely still do they intercept the beak of a small catheter in its passage towards the bladder (Pl. LXXVII., fig. 1 *a*). The mucous membrane of the urethra is covered externally by a layer of fibrous and non-striated muscular tissue, and it is in this bed that the inflammatory products contract in organic stricture. In the spongy part of the canal this submucous layer is composed chiefly of vascular and erectile tissue. It is perhaps on account of its great vascularity that the mucous lining of the spongy urethra is so prone to the absorption of irritating and morbid products. Outside this layer is the general fibrous investment, and over all is the muscular expansion from the accelerator urinæ.

Around the membranous part of the urethra is a considerable quantity of fibrous tissue, and at the narrowing anterior end of this part of the canal the careless introduction of a small catheter may do great damage. In front of the triangular ligament the spongy portion of the urethra is expanded (in a bulb), especially at the floor, and unless the beak of the instrument be kept carefully along the roof of the canal it is very apt to pass out and run up between the prostate and rectum. Hence the advisability of introducing the left index finger into, and keeping it in, the rectum in dealing with a troublesome stricture. In all probability the compressor urethræ does not by "spasmodic contraction" offer such a great bar to the passage of a catheter as it is generally represented to do. Muscular fibres have, indeed, been described by Wilson, which have as their office the widening of the urethra in this neighbourhood. The membranous portion of the urethra is in relation with the veins of Santorini, and with the connective tissue below the pubic symphysis. Behind and below it is overlapped by the bulb. It really belongs to the perineal region, being situated between the two layers of the deep perineal fascia (or triangular ligament).

In the prostatic part the urethra is enclosed by friable muscular and glandular tissue.

In old men the prostate is often found to be much increased in size, firm and lobulated, encroaching on the trigone and neck of the bladder and on the outer wall of the rectum, and this, by altering the length and curve of the urethra, gives rise to conditions which are so important that we must not attempt to enter on the subject in this small work.

proportion between the straight and curved parts. If the patient is young the curve will be less pronounced; for old men, on the contrary, and in cases of disease of the prostate or neck of the bladder, it is better to employ an instrument with a sudden curve. Before passing an instrument it should be warmed and oiled.

A catheter may be passed in the ordinary way, or by the "tour de maître."

1. *In the ordinary way, or from over the abdomen* (Pl. LXXVI., figs. 2, 3, 4).—*Position of the patient.*—The patient may be placed upright, with his back against a wall, or he may lie upon his back at the left edge of his bed.

Position of the surgeon.—The surgeon will find it most convenient to stand at the left of the patient, so that he may pass the instrument with his right hand, introducing the left index finger, if necessary, into the rectum to give him his bearings. The end of the penis is taken between the fingers and thumb of the left hand and drawn up towards the abdomen so as to straighten the spongy part of the urethra. (See Anatomy of the Urethra, and Pl. LXXVI., figs. 2 & 3.) The prepuce may require drawing back, and before introducing the instrument it may be well to draw the penis over toward the left groin. The catheter is taken in the right hand and held like a pen, the convexity being directed upwards. Introduced into the meatus, it must be pressed onwards with great care and gentleness, any roughness giving rise to pain and spasm. Thus the beak of the instrument reaches the level of the symphysis, and then the fingers of the left hand are glided down beneath the penis, and are placed in the perineum, feeling the instrument in the urethra; the handle by this time is raised perpendicular to the abdomen, and by gentle depression of the right hand the beak passes through the membranous part of the urethra and through the prostate into the bladder; and in depressing the handle the instrument sweeps up under the pubes. It is very necessary to keep the beak close under and along the roof of the canal.

The surgeon recognizes the instant that the instrument enters the bladder, and keeping his thumb or index finger over the opening of the catheter, directs it so that the urine may flow into the vessel prepared for it.

2. "*Tour de maitre.*"—This showy way of passing a catheter was much in vogue with the surgeons of the last century; it may be useful when the abdomen is large and pendulous. It is practised thus:—

Position of the patient.—He may be standing, sitting, or lying on his back, the last position being the best. The pelvis is brought to the edge of the bed, and the legs and thighs flexed and separated.

Position of the surgeon.—At the right side, or kneeling, or stooping between the thighs of the patient, the surgeon takes the end of the penis between his fingers and thumb, drawing it but slightly towards the abdomen. The catheter held in the right hand, with beak directed towards the perineum, the concavity looking downwards and backwards, is introduced into the meatus and passed down to the triangular ligament. The left fingers now embrace the root of the penis, and by giving the handle of the catheter a bold and rapid sweep from right to has had a considerable influence in directing the surgery of the urethra and bladder, especially as regards lithotrity.

Position of the patient.—He may be standing, sitting, or lying.

Position of the surgeon.—He places himself in front of the patient, and pulls out the penis with his left hand until it is at a right angle with the trunk. The instrument passed straight from before backwards passes beneath the pubes to the level of the bulb. Then the penis is drawn on the instrument and the handle firmly depressed so as to make the beak ride into the prostatic part of the canal and into the bladder (Pl. LXXVIII., fig. 1). If the first attempt fail, the instrument must be withdrawn a little and again pushed on. The penis must not be stretched until the symphysis is passed.

Obstacles to catheterization.—Accidents.—Remedies.—The various manœuvres that we have just described do not always succeed at the first attempt, and we will show in what the failure may consist and how it may be overcome. We must also point out the accidents which may arise in catheterization and how they are to be avoided, and the precautions which must be taken in passing a cathether in a wounded urethra. The difficulties may be due either to clumsy handling of the instrument, or to deviations in the direction of the urethra; from either cause a false passage may result.

False passages.—The beak of the catheter may be caught in one of the large follicular depressions so frequently found on the roof of the canal near the meatus; to avoid it the beak of the catheter must be withdrawn and then passed on along the floor of the urethra. Or the catheter may be stopped beneath the pubes, where the bulbous part joins the membranous, perhaps because the instrument is too much curved, perhaps because the handle has been depressed too soon; the instrument must be slightly withdrawn and then passed along nearer the floor of the urethra.

A common cause of difficulty is the catching of the beak in the bulbous enlargement of the urethra against the front of the triangular ligament. To avoid this the handle must be gently depressed; nothing is easier than to force the beak of the catheter through the pouch and up between the rectum and prostate.

Another obstacle may be found at the junction of the membranous and prostatic portions of the canal; and yet another at the neck of the bladder, where a wall of mucous membrane may be developed.

These obstacles may be overcome by passing the beak of the instrument along the roof of the urethra. From this short account it is evident that a correct knowledge of the length, shape, and size of the various parts of the canal must be obtained.

Lesions of the canal.—In this category must be placed the numerous causes of obstacle to the passage of the catheter, but all are not of equal importance. The instrument may be intercepted by one of the lacunæ (Plate LXXVII., fig. 1*a*), by a dilated prostatic duct, or by the opening of the common ejaculatory duct; but such an accident can only happen to a fine instrument. When one is passing a full-sized catheter such a cause for failure is out of the question. But when a stricture exists, or when enlargement of one lobe of the pros-

False passages are generally formed in the floor of the urethra near the bulb. and may give rise to hæmorrhages and the infiltration of urine. Their presence may be suspected when free bleeding occurs, or when the handle wanders away from the median line; the left index finger should at once be introduced into the rectum, where the beak may be found lying in front of the muscular wall of the bowel, and in dangerous proximity to it. The prostate gland ought to be felt between the catheter and the rectum.

Often false passages exist when the surgeon is called in to relieve a case of retention of urine, or to dilate a stricture. If he find out their situation he must carefully avoid them, keeping his finger in the rectum; and it must be confessed that the operation in these cases is one requiring the greatest skill and patience.

PLATE LXXVII.

FALSE PASSAGES. — STRICTURE OF URETHRA.— PLASTIC OPERATIONS. — ENLARGEMENT OF MEATUS.—FIXING INSTRUMENTS IN URETHRA.

Fig. 1.—*Accidents of catheterization.*—*a*, beak of instrument caught in a lacuna; *b*, the same having traversed the mucous membrane and re-entering the canal; *c*, *d*, catheters caught in old false passages in the prostate, tunnelling its tissue; *e*, urethral crest; *f*, bladder with thickened walls.

Fig. 2.—*Passage of bougies through stricture.*—*a*, meatus; *b*, conical extremity of a bougie caught in the stricture; *c*, bulb; *d*, symphysis of pubes; *e*, prostate; *f*, cavity of bladder.

Fig. 3.—*Cauterization of the prostatic part of the urethra, with M. Lallemand's instrument.*—*a*, meatus; *b*, membranous portion with the instrument carrying the caustic; *c*, prostate; *d*, symphysis; *e*, bulb; *f*, bladder.

Fig. 4.—*Cauterization of the membranous part of the urethra with the straight instrument.*—*a*, canula of the *porte-caustique*; *b*, part of the instrument armed with caustic; *c*, prostate; *d*, symphysis; *e*, bulb; *f*, bladder.

Fig. 5.—Division of stricture.—*a*, meatus ; *b*, conical point of scarifier in the membranous part of the canal ; *b''*, enlargement of scarifier ; *b*, *b*, *b'*, blade protruded from the protecting enlargement by a movement of the handle ; *c*, prostate ; *d*, symphysis ; *e*, bulb ; *f*, bladder,

Fig. 6.—Antero-posterior section showing a stricture of urethra.—*a*, meatus ; *b*, stricture with dilatation behind it, whilst the urethra in front of it (from *a* to *b*) is narrowed ; *c*, commencement of the membranous part of the canal ; *e*, internal orifice of an antero-posterior fissure situated on the floor of the spongy portion.

Fig. 7.—Plastic operation.—*a*, a sound ; *b'*, the same seen through the urethral fistula ; *b*, penile fistula. A dotted line shows the extent to which the surfaces have to be vivified around the opening ; *c*, a flap to be raised from the root of the penis and scrotum. This flap must be rather larger than the gap on to which it will afterwards fall.

Fig. 8.—Operation by lateral incision.—*a*, sound in urethra ; *c*, fistula whose vivified edges have been brought together by sutures, *c'* ; *b*, *b'*, lateral incisions made at a distance from the

"spasmodic stricture." "I will tell you what spasmodic stricture often is. It is an exceedingly useful excuse for the failure of instruments. It is a 'refuge for incompetence.'"

Spasmodic stricture should be called urethral spasm, being simply a spasmodic contraction of the muscular fibres surrounding the urethra.

3*rd*. *Organic*.—These are the most common, and follow on injuries to the urethra, and as the result of chronic urethritis. They are the most obstinate as regards treatment, and when a man is once the subject of one he can never be *cured*. The bad effects may be kept under control; but so surely as the patient and surgeon leave off attending to the stricture, so surely does a relapse take place—it is only a question of time.

There may be one or many strictures in the same urethra; they may appear as small or large cicatrices, fibrous rings surrounding the canal, bridles, or as a general thickening all around a certain part of the canal.

The narrowness of the aperture will vary with the degree of thickening in the sub-mucous coat. As a rule, the older the stricture the smaller the opening. The mucous membrane in the neighbourhood of the stricture becomes altered in appearance, so that the terms *indurated* and *fibrous* are often employed in describing the parts; they mean this,—that the chronic inflammation has given rise to a considerable amount of plastic deposit in and beneath the mucous membrane, a deposit which has become organized into thick fibrous tissue.

Traumatic strictures may be found anywhere along the urethra. Organic contraction following gleet generally occurs in the neighbourhood of the bulbous end of the spongy portion. An enlargement of the prostate, blocking up the canal, cannot properly be included amongst the strictures.

The surgical therapeutics comprise preliminary explorations, palliative and radical treatment. We avoid the word *cure*.

Preliminary operations are to give information concerning the number, size, and situation of the stricture.

The introduction of ordinary catheters of different sizes is generally sufficient to give the surgeon every information that he requires for undertaking the treatment of a stricture; but when about to operate, one must be careful and precise in making the preliminary examination. Ducamp used to employ what he called his *exploratory sound*, but the instrument has properly fallen into disuse. The simpler the instruments the better.

The instrument *à boule* in gum-elastic renders service in measuring the length of a stricture; but when the thickening in the sub-mucous coat exists in the spongy portion only, the surgeon can obtain a good idea of its extent by gently pinching it between his finger and thumb.

TREATMENT.

Dilatation.—Dilatation is the method to be preferred in the treatment of most tight organic strictures. The best way of performing it is to employ the No. 1 (English scale), for instance, on the first occasion, and having ascertained by the finger in the rectum that it is in the proper course for the bladder, to urge it gently onwards; when it has reached the bladder, urine having flowed, it should be withdrawn. On the third catheter split down the middle, the halves being joined by a hinge near what would be the eye of an ordinary catheter. Running between the halves and fixed to the hinge is a slender wire stylet, over which a large hollow style. of the size of a No. 8 or 9, is passed. In its passage over the stylet it separates the halves of the instrument and so bursts up the fibrous constriction.

The instrument has met with little approval in the hands of some surgeons, and condemnation from others, but a fair trial of its merits in unprejudiced hands shows that most organic strictures can be quickly and effectually treated by its means.

Simple division.—In this operation a cutting instrument is passed through the stricture dividing some of the constricting tissue. The instruments are called *urethrotomes*. They vary much in form. They may be straight or curved, and cutting from behind forwards, when passed through the narrow track. For the most part they consist of canulæ, varying in size, and are armed with a stylet, which has a hidden blade at its vesical end. Sometimes the blades are terminal, at others they start out through a lateral slit in the instrument on pressure being made through some arrangement of screw or lever. When the urethrotome is curved, the blade is situated at the convexity. The blade may be single or multiple. Some of the instruments cut their way through the stricture in passing through towards the bladder; but generally the cutting is effected with the withdrawal.

The instruments are used thus. When the stricture has been somewhat dilated, and a good knowledge of its extent and condition has been obtained, the urethrotome is introduced with the blade hidden; the beak is then passed beyond the narrowing, so that when the blade is made to start out it is on the bladder side of the stricture. The blade is then made to cut its way forward through the tight band, without wounding the healthy part. If advisable, the band may be divided in more points than one; the blade must be made to return under cover again ere the instrument is withdrawn. Some bleeding may follow the operation. From time to time a full-sized catheter must be introduced to prevent the return of the contraction.

M. Reybard, not satisfied with division of the fibrous ring of the stricture, proposed to divide, in addition, the healthy tissues of the urethra right through the copus spongiosum to the skin, the section being effected by a blade like that of a penknife. We only mention the operation to condemn it.

M. Werteimber has employed electricity in the treatment of stricture.

Some have tried to force a passage through the narrowed part of the canal by cauteries; whilst others have endeavoured to effect a cure by excision of the morbid tissue.

M. Amussat has sometimes succeeded in introducing a catheter through an obstinate stricture by forcibly distending the urethra with warm water, and for this he has a small catheter with an india-rubber ball at one end, which, filled with water, can be forcibly emptied by the hand into the urethra, the other end of the catheter being passed down to the stricture. By gently forcing on the catheter after the injection the stricture has been penetrated. Whilst the injec-

Should the fistula be associated with stricture, the latter must be dealt with before the former is touched. The great difficulty of obtaining a complete success is due to the union of the vivified surfaces being hindered or prevented by contact with urine. Often one sees a perineal fistula heal spontaneously on a stricture being dilated.

Indirect treatment.—Old plan.—A catheter is introduced into and fixed in the bladder, and the small plug of wood is removed each time that the patient desires to pass water. The urine, however, sometimes finds its way to the wound by passing between the catheter and the walls of the urethra. To prevent this some surgeons have left the catheter without the plug of wood, so that the urine might flow away as it is secreted. Simple fistulæ in the perineum occasionally heal under such methods of treatment. On account of the severe inconveniences resulting from the catheter being allowed to remain in the bladder, Ducamp has proposed to draw off the urine by passing a catheter each time the patient has the desire; but the irritation set up by urine collecting in the bladder is occasionally so severe that the patient cannot wait to have the instrument passed, so that no good result can be anticipated with certainty from this method of treatment.

Direct treatment. — Perineal fistulæ often require free divisions ere they can be obliterated, but no excision of the tracts need be practised.

A plastic operation may be required when there has been a loss of tissue at the floor of the urethra in the spongy portion of the penis, but it is very apt to fail. The edges of the fistula are pared and brought together by wire sutures over a gum-elastic catheter introduced into the urethra; but M. Malgaigne considers that its presence in the canal is productive of harm, and that repeated catheterizations are to be preferred.

Perhaps when the nature and use of Mr. Napier's self-retaining convolvulus catheters are better understood, the treatment of penile fistula may be more satisfactory. In most cases it is well to make an opening into the urethra in the perineum, and allow the urine to escape by it whilst the wound at the front of the scrotum heals.

When the gap in the floor is extensive it will be necessary to make use of a flap cut from one side of the thin penile covering, and, bringing it across the opening, to let it fall into a space which has already been excavated for it on the opposite side.

Partial successes are by no means uncommon in these cases, and it is often only after repeated attempts that the opening is entirely closed.

Imperforation of the glans.—Enlarging the meatus (Plate LXXVII., figs. 9 & 9 *bis.*).—Should the imperforation of the glans be congenital, the aid of the surgeon is at once required. Generally in these cases the urethra is distended behind the obstruction, so that a simple incision, or an excision combined with puncture, will be all that is necessary.

After the operation care must be employed lest the new passage be again blocked up by cicatrization.

Should there be congenital narrowing of the meatus, oft-

PLATE LXXVIII.

CATHETERISM AND LITHOTRITY.

Fig. 1.—*Rectilinear catheterism.*—*a*, position of the instrument at the start; *a'*, position showing the inclination necessary to pass the (*b*) triangular ligament; *a''*, the instrument entering the bladder, the handle having passed through the quarter of a circle, *g h*; *c*, prostate; *d*, symphysis; *e*, bulb; *e'*, testicle; *f*, bladder.

Fig. 2.—*Passage of a metallic sound.*—*a*, first position; *a'*, when introduced into the bladder; *b*, the beak passing through the prostate, *c*; *d*, symphysis; *e*, bulb; *f*, bladder.

Fig. 2 ***bis.***—*Sounding for stone.*—*a*, sound entering bladder, *f*; *c*, prostate; *d*, symphysis, *e*, bulb; *e'*, testicle; *g*, stone lying at base of bladder behind prostate. This diagram shows how necessary it is to employ a sound with a short and sudden curve, and also how much assistance may be occasionally obtained by pushing up the base of the bladder by the left index finger in the rectum.

Fig. 3.—*Extraction of a urethral calculus.*—*a*, *b*, small straight forceps introduced into the membranous part of the urethra; *b'*, the fragments seized in its bite; *c*, prostate.

Fig. 4.—*Crushing a stone by percussion.*—*a*, lithotrite; *a'*, female blade, which allows the toothed male blade to play in it, so that the stone may be readily fixed in the bite; *a''*, circular plate on the male blade for manipulation by the finger; *a'''*, disc-like head of male blade for receiving the strokes of the hammer. The lithotrite is firmly held between the two hands of an assistant, and steadied by the operator's left hand whilst he uses the hammer with the right. *b*, end of lithotrite in bladder, *f*; *b'*, male blade; *b''*, female blade; *c*, stone. A window has been cut through the hypogastric region of abdomen. This instrument is now superseded by a stop screw.

Fig. 4 ***bis*** shows the way in which the stone is caught and held by the blades being approximated by manipulation with the male blade.

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child, then, unless the stone be small, lithotomy is the operation to be selected; in the male child there is, as we have shown above, no alternative on lithotomy.

Briefly, then, lithotrity is to be performed on the healthy adult male when the stone is small and not too hard. In all probability these patients would do equally well under lithotomy; in fact, they would be, after children, the very patients selected by the lithotomist. So the lithotritist picks his patients, and is wise in his choice; but it is questionable to compare the happy results of such operations with those of the lithotomist, who has had to undertake the treatment of the most unpromising cases.

Nor is this all. When the lithotritist commences the comparison, he objects to the children being counted by the lithotomist.

Sometimes, after a patient has failed to be relieved, he is submitted to, and succumbs under, the cutting operation. Therefore, if there be any doubt about which method of treatment should be employed, the preference should at once be given to the cutting operation. Should any urethral stricture exist in a patient who might have his stone crushed, the treatment of the former must be first undertaken.

Should a patient be the unfortunate subject of cancer of the bladder, as well as of stone, no operation would appear advisable.

THE OPERATION AND INSTRUMENTS FOR CRUSHING A STONE IN THE BLADDER.

The patient should retain his water for some few hours before the operation.

At the first attack upon the stone—the sitting, as it is generally called—the surgeon may content himself with breaking it into two or three large pieces; or he may, if he think fit, continue the operation to breaking up each separate fragment into powder, or into pieces small enough to pass readily by the urethra. It is by no means necessary that the patient be put under the influence of an anæsthetic. If he seems to suffer little or no pain or inconvenience from the

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The surgeon should stand on the right side of the patient, so that his right hand may be in a convenient position for manipulating the handle of the lithotrite. If there be not a sufficient number of assistants it will be advisable to fix the patient's wrists to the ankles, the thighs and legs being flexed after the introduction of the instrument.

The introduction will be effected as we have described further back (see *Catheterization*), and it may be necessary to divide slightly the meatus urinarius. As soon as the calculus is felt the blades are separated by a sliding movement at the handle (not by the aid of the screw), and the opened blades are then turned round to where the stone is supposed to lie. The male blade is then slid down on to the stone and the screw put into gear. The wheel at the handle is then turned forcibly and steadily so as to crush the stone. Supposing the stone is not caught the first time, the blades must be again separated and turned to the other side, and, if necessary, must be made to dip down behind the prostate, when useful aid may be afforded by the left index finger introduced into the rectum or vagina. Supposing that the stone slips suddenly from the bite, it must be searched for again. In any case, when it is fairly caught it will be well to give the instrument a turn or two on its long axis so as to make sure that the mucous membrane is not by any chance caught; and this and every other movement must be executed with the greatest delicacy; for it must be remembered that the patient will not be able to inform the surgeon if a fold is included or not. Should the stone be small and not too hard, it may be pulverized there and then, at the first attack; but should it be otherwise, the surgeon must rest content with knowing that he has broken it into fragments, and has, in addition, crushed some of those fragments. The "sittings" should be short and oft-repeated, rather than prolonged. Two minutes should be sufficient time for the purpose. Fragments should not be withdrawn with the lithotrite, but should be crushed. Nothing more than powder should be removed between the blades, and it is very necessary to see, by inspecting the handle, that the male blade is well home before an attempt is made to withdraw the instrument. Two or three days should intervene between the sittings.

The *débris* of the stone is passed, as we have said above, as the patient is lying down; but should an angular fragment become impacted in the urethra it must be removed by the long and slender scissor-forceps. Rarely will it be necessary to extract it by an incision. Should the bladder have lost all power of evacuation, Clover's syphon will be of great service in getting rid of the powder and small fragments.

Accidents.—Attention to the precautions which we have just given will avoid injury to the bladder and urethra; but it occasionally happens that the male blade snaps off at its angle. The fragment may be removed by the aid of another lithotrite; but if this appear impracticable, the patient must be submitted to the operation of lithotomy. Cystitis, nephritis, peritonitis, or retention of urine, may follow on lithotrity, and so also orchitis and prostatitis. Slight or severe febrile symptoms are by no means uncommon. Inflammation of the plexus of veins about the neck of the

PLATE LXXIX.

SURGICAL ANATOMY OF THE PERINEUM.

Fig. 1.—*The perineum.*—The left half of the figure represents the superficial layers; the right half the deep structures, the superficial fascia being preserved on the left half: *a*, the anus with the external sphincter, half dissected; *b*, the bulb of the urethra covered by the accelerator urinæ; *c*, the internal pudic vessels, the artery being superficial and external to the vein. These vessels, traced backwards over the spine of the ischium, enter the pelvis below the pyriformis; but traced forwards, under the protection of the tuberosity and ramus of ischium and pubes, they lie between the two layers of the triangular ligament, giving off branches in their course; these are, *f*, the superficial perineal, for the supply of the scrotum, and *f'*, the inferior hæmorrhoidal which passes inwards towards the anus.

The most important branches are the artery to the bulb, which runs from the front of the ischial tuberosity forwards and inwards, and the transverse perineal, which courses along the posterior border of the transversus perinei. These are accompanied by corresponding veins. The internal pudic artery ends in the artery for the corpus cavernosum and the dorsal artery of the penis; *e*, section of glutæus maximus; *g*, *g*, skin. The origin of the adductors and the fascia lata, the coccygeus and levator ani, and the coccyx are also seen; *h*, *h*, testicles; *i*, the penis.

Fig. 2.—*Bilateral lithotomy.*—*Introduction of the staff and incisions in the skin.*—*a*, anus; *b*, transverse incision across perineum between anus and bulb; *c*, the index finger feeling for the groove in the staff; *d*, bistoury; *e*, bulb; *f*, meatus; *g*, the staff held vertically in the middle line; *h*, testicles drawn up by the assistant who holds the staff.

Fig. 3.—*Incision through prostate in the bilateral section.*—The coverings have been removed to show, *a*, the internal pudic vessels; the bulb, *b*, covered by the accelerator urinæ; the inferior surface of the prostate, in which is noticed the [illegible] vator ani.

Fig. 3 *bis* shows the way in is introduced, the blade being hic

Fig. 4 shows the way in whic tate is cut by the single lithotome also followed by the lithotomy kn the second part of the lateral ope backwards and outwards betwee internal pudic vessels.

Fig.* 5.—*Extraction of the stone the right hand, the blades being s left hand.

Fig. **6 shows a modified operat passing backwards in the middle li front of the rectum. (*Median Rec***

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LITHOTOM

Lithotomy is the operation in through into the bladder for the foreign bodies generally. Every v the ingenuity of surgeons could bladder has been attempted ; but here with describing the methods England. A special

the bladder, and, further out, the trunks of the internal pudic vessels and nerve.

The surface markings are, in the middle line, the urethra with the bulb; behind this a slight depression can be made out which corresponds to the central tendon of the perineum, and further back still is the anus. In front is the root of the scrotum, with its median raphé. The fossa at the side of the urethral tube is limited externally by the rami of the pubes and ischium. Behind it loses itself in the ischio-rectal fossa.

The skin is thin, brownish, and elastic, being covered with scattered hairs and sebaceous follicles. Beneath the skin is the superficial fascia disposed in two layers, of which the superficial contains non-striated muscular fibres and becomes continuous with the fatty layer on the thighs and in the ischio-rectal fossæ. The deeper layer of the superficial fascia is thin and membranous; it is attached externally to the rami of pubes and ischium, posteriorly to the base of the triangular ligament, and looping around the scrotum in a wide sheet passes up to the abdomen and around the penis. On the abdomen it is attached to Poupart's ligament and to the outer lips of the crest of the ilium. This deeper layer of the superficial fascia plays a most important part in cases of ruptured urethra, for, whilst preventing the urine from passing down the thighs or into the ischio-rectal fossæ, it guides it up on to the abdomen by way of the scrotum and penis, and in the direction of the spermatic cord. This layer of fascia covers in an important triangular space, limited by the following muscles: externally by the erector penis, posteriorly by the transversus perinei, and in the middle line by the accelerator urinæ. Under this fascia are found the superficial perineal branches of the internal pudic vessels and nerve, and, probably, the small transverse perineal branch of artery. In the depths of the space is seen the triangular ligament of the urethra, or the true deep perineal fascia. Into this triangle the surgeon plunges the knife in the beginning of the lateral operation of lithotomy to reach the groove in the staff between the two layers of the triangular ligament, and, cutting backwards and outwards to the interval between the anus and the ischial

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with the back of the pubes and the bladder under the pubo-prostatic or anterior true ligaments of the bladder. Passing down to the side of the prostate are the anterior fibres of the levator ani.

After the knife has reached the groove in the staff it is made to travel on from the membranous part of the urethra through the side (left) of the prostate and the neck of the bladder, dividing in its course a few fibres of the levator ani.

Position and course of incisions in the lateral operation.—The superficial incision should not be started too far forwards lest the bulb of the urethra or its artery be injured. The surgeon must feel for the prominence of the bulb at about an inch and a half in front of the anus of the adult, and should plunge his knife boldly in towards the membranous part of the urethra behind the bulb and close to the left side of the median line. Nothing is gained by keeping the point of the knife well forward at the commencement of the operation; the ripping up of so much of the canal is undesirable. This incision must extend to a point between the tuberosity and the anus, and a little nearer to the former, well back into the ischio-rectal fossa, so that the inferior extremity of the passage cut into the bladder may be the most capacious part, and so that urine may have no impediment in its flow to the exterior of the perineum. It is well also that the operator endeavour to hit the staff in the first plunge of the operation; if this be effected the following parts will have been divided by the time that the knife has emerged from the ischio-rectal fossa: skin and superficial fascia, branches of the superficial perineal vessels and nerves, the transverse perineal vessels and muscle, the base of the triangular ligament, the membranous part of the urethra with the compressor urethræ, the inferior hæmorrhoidal vessels and nerves, and the fat in the ischio-rectal fossa.

Now, before this incision is made, the surgeon must have obtained a thorough knowledge of the anatomical position of the tuberosity and the ramus of the ischium, the anus, and the rectum. He must assure himself, by introducing his finger into the bowel, that the rectum is not distended with fæces

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part of the bladder, lest, the pelvic fascia being freely divided, urine find its way into the loose tissue in the floor of the pelvis, and infiltration ensue. But in the child it is impossible to keep the incision in such narrow limits, on account of the exceedingly small dimensions of that gland.

The incision, however, must not be too cramped, especially in the child, lest, on account of the slender connections of the neck of the bladder, the whole viscus be pushed up into the pelvis by the finger which seeks the stone. No doubt many of the cases in which no stone has been found at the time of the operation have been consequent upon the incision into the bladder not being properly made.

Knowing, then, that he has opened the neck of the bladder, the surgeon passes the left index finger on to the groove in the staff and works it over the concavity of the staff into the bladder, hooking down, as it were, the staff in the endeavour to reach the interior of the bladder. Then he feels for the stone, and having his finger against it, he requests his assistant to withdraw the staff. The finger thus introduced dilates the wound, and over it is passed the forceps; the stone is seized and worked out by lateral movements. It must not be pulled straight out, lest damage be done by laceration. If the stone is very large, a nick may be made into the right side of the prostate, or if it proves to be a calculus of enormous size it must be crushed, or the supra-pubic operation must be at once performed. A "petticoated" tube may be introduced into the bladder, and there left if there seems to be much hæmorrhage; a syringeful or two of cold water will generally be enough to check oozing.

The following rules deserve the attention of the young lithotomist. Never cut a patient unless you can strike the stone when you are about to operate. Let your first incision be free, so as to get plenty of room for the second, which should not be made too far forwards nor of too limited an extent. Be sure to lay the staff well bare before running the knife towards the bladder. Never allow the staff to be withdrawn until you have touched the stone with your index finger. Take no thought of dash, display, time, or lookers-on, but proceed step by step with care and certainty. If the rectum is prolapsed as you are about to commence, do not diminish the space required for your incisions by returning the protruded part.

The Median Operation.—By the "Median Operation" is meant the removal of a stone from the bladder by an incision through the middle line of the perineum. This method of procedure was, in late years, revived by Allarton, who was of opinion that the bladder could by its means be opened with a much less injury to tissues, especially as regards the pelvic fascia, and with less risk of damaging important arterial branches, such as the artery of the bulb and irregular trunks from the internal pudic.

A full-sized staff, with a groove running along the convexity, having been introduced into the bladder, the patient is tied up in the usual way. The surgeon then introduces his left index finger into the rectum, and, feeling the staff in the urethra, keeps the end of the finger against the apex of the prostate gland. The point of the knife is now plunged into the perineum about half an inch in front of the anus, the back unfavourable the prognosis. Certainly there is less risk of hæmorrhage following on the median than on the lateral operation, and less risk of opening up the reflections of pelvic fascia, and of death occurring from urinary infiltration into the connective tissue of the pelvis. But as the incision lies so far to the front of the pelvic outlet, there is, evidently, little chance of being able to remove a large stone by the median operation. If, to obtain greater space, the incision is taken far forward, the bulb would be cut; if taken backward the rectum would be opened.

The "*medio-lateral*" operation is performed much in the same manner as the median, but in order to obtain more room for reaching and extracting the stone, the incision is carried backwards and outwards from the membranous part of the urethra into the ischio-rectal fossa.

By the use of Buchanan's rectangular staff, the angle of which is made to project well into the perineum, the bladder is reached with great ease.

Dupuytren's bilateral operation was introduced with a view to obviate the risk of wounding the bladder unnecessarily, or of cutting beyond the limits of the pelvic fascia, as it surrounds the prostate. Both lobes of the prostate being divided, it is held that ample room is obtained without further cutting or rough dilatation. The operation is rarely performed in England because, since the days of Cheselden and Liston, the simple lateral operation has been found to fulfil almost every requirement.

The staff, which has a wide median groove in its convexity, is passed and held in the usual way, and the surgeon, with his left forefinger introduced into the rectum, makes a crescentic incision just in front of the anus, the convexity being directed forwards. The ends of the incision are carried round into each ischio-rectal fossa. Cutting down, layer by layer, and guarding well the rectum, the surgeon at last exposes the staff as it lies in the membranous part of the urethra (Pl. LXXIX., fig. 2). Guided by the groove on the staff, the *lithotome caché* is then introduced into the bladder, the concavity being turned upwards (fig. 3 *bis*), The staff is now withdrawn and the

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Fig. 1.—*Antero-posterior*
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Fig. 2.—*High operation.—Sec*
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thumb and fourth finger being passed through the rings of the forceps. The left hand steadies the forceps nearer the wound, and helps in traction; *d* and *d′*, edges of wounds.

Fig. 6.—*View of the interior of the bladder*, the upper and back parts having been removed, so as to show the line, *e*, of the hypogastric section; *g*. the incision for the median operation; *f*, *f*, shows the bilateral section of Dupuytren,—the half on the left side would pretty nearly indicate the line of incision in the English operation; *b*, ureters; *h*, seminal vesicles. The body and rami of the pubes are marked in dotted outline.

SURGICAL ANATOMY OF THE SUPRA-PUBIC REGION.

When the bladder of the adult is empty it lies deeply in the pelvis, hidden behind by the pubes; but when distended it rises high up, nearly to the umbilicus, and pushes up with it the peritoneum, leaving always the surface of the bladder behind the anterior abdominal wall bare of serous coat. Of this fact the surgeon takes advantage in certain operations. The skin of this part of the abdominal wall is thickened above the pubes by a considerable addition of fat, constituting in the female the mons veneris. The region in the middle line, corresponding to the linea alba beneath, is covered by a longitudinal streak of hairs. The skin in this line is a little darkened, and beneath may be made out the furrow between the recti abdominis; but in a very fat subject the situation of the linea alba can only be distinguished by drawing a line on the surface from the symphysis pubis to the ensiform cartilage. The amount of fat in the superficial fascia varies; it is as a rule more abundant in women than in men, and may increase to such an extent in either case as to render the wound in the high operation for stone excessively deep.

On either side of the linea alba is the rectus abdominis in its sheath; the muscle is narrower near the pubes than elsewhere. In front of the rectus in this neighbourhood is the pyramidalis, an accessory muscle, which is inserted into the linea alba. The rectus arises from the crest and symphysis of the pubes, and passing straight upwards is inserted into the cartilages of the lower *true* ribs. The borders of the muscle are thinner than the middle portion, and along the outer edge is seen a somewhat crescentic marking, corresponding to the border of the rectus and the ending of the fleshy fibres of the oblique muscles in the aponeurosis; this is called the linea semilunaris. The deep epigastric artery, a branch of the external iliac, lies so far away from the inner border of the rectus that it is in no danger of being wounded in suprapubic lithotomy.

Behind the lowest part of the rectus no sheath is found, but the muscle lies upon a layer of condensed connective tissue known as the transversalis fascia, which varies much in character, being sometimes thick and strong, at others loose and lax, or impregnated with fat. It separates the posterior surface of the anterior wall of the abdomen from the peritoneum and the distended bladder, and is often firmly attached to the linea alba.

The remains of the urachus and of the two hypogastric arteries are found between the peritoneum and the recti.

himself in the linea alba, above the pubes, and took out of his bladder a stone as large as a hen's egg. "The stone, the knife and the portrait of the operator, may be seen to this day in the Museum at Leyden."

The operation is unsatisfactory on account of the frequency of injury to the peritoneum, and also on account of the danger of urinary infiltration. About one in three is the proportion of success.

The operation is thus performed: the patient is placed on his back, and an incision three or four inches in length is made in the middle line down to the pubic symphysis. A catheter introduced by the urethra is steadily held by an assistant, the handle being well depressed so as to make the beak approach the hypogastric region in the middle line. This will be a sufficient guide to the surgeon without injection of the bladder. The operator will work through the lower part of his incision, keeping close towards the pubes, cutting through the fibrous structures of the linea alba. Having divided the transversalis fascia, he will strip up the peritoneum with his fingers, and feel down behind the pubes for the end of the catheter, over which he will make an incision. A soft gum-elastic catheter will be allowed to remain in the bladder for a few days, so as to keep urine from the wound.

Though this operation is performed but rarely in the present day, nevertheless a deformed pelvic outlet, or anchylosed femora will occasionally render its selection imperative. There are several methods of performing it described; but the simple one to which we have just called attention is to be preferred. A scalpel, scissors, director, dissecting forceps, catheters, calculus forceps, retractors, needles and sutures will be all the instruments that are required.

PLATE LXXXI.

OPERATIONS PRACTISED ON THE GENITAL ORGANS OF WOMEN.

CUTTING FOR STONE IN WOMEN.

Fig. 1.—*Anatomy of the perineal region in women.*—*C*, anal sphincter; *C′*, constrictor vaginæ; *P*, anus; *V*, vagina; *s*, clitoris; *u*, meatus urinarius; *m*, *m*, superficial branch of the internal pudic artery; *b*, clitoric, or deep branch; *l*, *l*, transverse muscle; *i*, *i*, middle aponeurosis; *a*, *a*, internal pudic artery; *f*, *f*, gluteus maximus; *r*, levator ani.

Fig. 2.—*The vestibular operation in women.*—*Method of Lisfranc.*—*First step of the operation.*—*A*, curvilinear incision practised in the vestibule, and designed to give exit to the calculus; at the same time the vestibular space is enlarged by lowering the urethra, *u*, by means of the catheter, *S*. *b*, *b*, fingers of assistants keeping the labia majora apart; *V*, external orifice of the vagina; *l*, *l*, labia minora.

Fig. 3.—*Urethral operation in women*, seen in profile section two regions—the one posterior, or anal; the other anterior, urethral or perineal, properly so called.

There is nothing to add respecting the first, in which the same elements are met with: in the centre is the rectum, which descends surrounded and supported by the levator ani, ending below in the anal orifice (*P*, fig. 1), itself surrounded by the anal sphincter, *C*, and presenting right and left the ischio-rectal space bounded by the obturator internus and levator ani, and their aponeuroses. This space, filled with fat in the recent state, is traversed by the internal pudic artery, *a*. It is less deep in women than in men; but it is more extended transversely, which is explained by the greater separation of the two ischial tuberosities, which diverge obliquely outwards, and are less prominent.

The result is that the anus is not so deep, and it is found on nearly the same plane as the two tuberosities, without the great quantity of cellulo-adipose tissue with which the skin is thickened at the level of these prominences.

In front, on the contrary—that is to say, in the perineal region properly so called—we have to point out notable differences, which do not affect the disposition of the superposed layers or planes, but the organs which traverse these layers. Thus this portion of the perineum is, like the preceding, traversed through the centre by a membranous canal (the vagina, *V*, fig. 3), situate between the rectum and the bladder, surmounted by the uterus, the neck of which it embraces, and of which it may be considered the excretory duct. This canal ends below at the vulva. In front it is in immediate relation with the urethra.

The vagina and urethra traverse the perineal aponeuroses, the disposition of which is the same as in man.

The vulva, or the whole of the external parts of generation, presents itself externally in the form of an elongated fissure from the mons veneris to one inch in front of the anus.

The fissure is bordered on each side by two more or less projecting cutaneous folds, which are the labia majora. These, opposed to each other by the internal surface, are free, and covered by hairs on their external or cutaneous surface.

.., their posterior extremity to form a membranous fold, fourchette, which is nearly alw

One finds in their thickness da follicles, an expansion of the *fa* ficial aponeurosis.

On separating the labia ma formed by erectile tissue and cov is here abundantly endowed wit folds, the labia minora, less de commence internal to the labia posterior third of the vulva, by a in front by uniting together.

Here they cover a small roun more or less prominent, and forme or rather of a cavernous body spr rich in nerves, and surrounded by lines the mucous membrane.

a, *a*, internal pudic artery.

Behind the posterior border of this artery divides into two branch which is destined to the labia ma other deep, or clitoric artery, whic

Veins accompany the arteries. which come f

It is the anterior part, the termination of the column or anterior longitudinal crest of the vagina, slightly enlarged in the form of a tubercle.

The space which separates the clitoris from the meatus urinarius, and which is bounded on each side by the angular opening of the two labia minora, has received the name of vestibule, and is of some interest to the surgeon on account of its great dilatability, which allows him to obtain a space more than double (one inch or more) when the urethra is depressed backwards, or when, after labour, or from any other cause, the meatus urinarius, carried upwards, rises to behind the symphysis pubis.

Below the vestibule, and at the level of the urethral tubercle, begins the vaginal orifice, which occupies all the posterior part of the vulva nearly to the fourchette, from which it is only separated by a small triangular space, the fossa navicularis. This orifice is, in virgins, more or less closed by a thin membrane, somewhat disposed in the form of a diaphragm, with a central aperture, sometimes like a crescent, of which the free concave border looks forwards. It is this membrane, known as the hymen, which is torn during coitus, and is represented by little tubercles called carunculæ myrtiformes.

Outside these caruncles the excretory canal of the vulvo-vaginal gland opens.

The vagina, *V*, a short distance from its external orifice, is embraced by the spongy body which has received the name of Bulb of the Vagina.

The walls of this membranous canal are constituted by a layer of erectile tissue, by fibres of dartoid tissue, of which one set, longitudinal, arranged on the anterior and posterior aspects, form within the vagina two projections, which have received the name of Columns of the Vagina, and of which the others, circular or curvilinear, extended from one column to the other, and forming within a great number of transverse folds, raise the mucous membrane, which covers or invests the internal surface of the organ. Lastly, at the level of the external orifice there is a veritable ring of muscular fibres, the sphincter or constrictor vaginæ, *C'*. The mucous membrane

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tissue in such a manner that the peritoneum, which is reflected over the posterior surface of the bladder, does not descend to the vagina. The arrangement is not the same behind, where the vagina, immediately connected with the rectum, in its middle part, is separated above by the peritoneum reflected from the anterior aspect of the rectum to the posterior aspect of the vagina, forming the recto-vaginal cul de sac, of which the bottom is rather more than an inch from the surface of the perineum. Below, the vagina, on account of its curve, deviates from the rectum, and is separated from it by a cellular tissue; *c*, vesico-vaginal septum; *d*, recto-vaginal septum.

Situate in the pelvic cavity between the bladder and the rectum is the uterus, *a*, of an ovoid shape of which the larger end is upwards. The two upper thirds form the body of the organ; the lower third constitutes its neck.

The uterine axis is generally considered as oblique from above downwards, and from before backwards. But from recent researches it is found that in the fœtus, the child, the young girl, in a word, up to the epoch of the first pregnancy, the axis of the body of the uterus forms with that of the neck an obtuse angle, an angle which may sometimes be even acute; so that these two parts, the body and the cervix, are flexed on each other.

In all cases the body and cervix are separated by a constriction; the anterior and posterior surfaces are convex; the upper and lateral borders, convex, unite by two rounded angles, which give attachment to the Fallopian tubes, the round ligaments, and the ligaments of the ovary.

The cervix uteri projects half an inch into the vagina, the walls of which are inserted around it. This projection presents in the middle the uterine orifice, the os tincæ. The form of the cavity of the uterus is elliptic at the level of the cervix, and triangular in the body, the two superior angles being continuous by a very narrow orifice with the cavity of the Fallopian tubes. The cavity of the cervix and that of the body are separated by a marked narrowing which can seldom be passed by the sound without difficulty, and without causing rather sharp pain.

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ligament which ends in an expansion in the cellular tissue of the mons veneris; the Fallopian tube, a slightly flexuous narrow tube, opening into the abdominal cavity by a fringed orifice; and lastly, the ovary and the ovarian ligament.

The *ovary* is the essential organ of generation in women, is united to the uterus by a fibro-muscular ligament, and has an ovoid shape flattened from before backwards.

In childhood, and up to the epoch of the first menstruation, the surface of the organ is smooth; then in proportion as the woman advances in age, this surface becomes uneven and fretted by the formation of numerous cicatrices which correspond to the evolution of ova.

The ovary is formed by a very dense fibrous membrane covered by the peritoneum of the posterior wing of the broad ligament, and constituting, by the prolongations which emanate from its interior surface, the stroma of the ovary, a species of fibrous mesh where the ovules form, or rather the Graafian vesicles, to which the corpora lutea succeed.

The ovarian arteries come from the aorta, the veins accompany the arteries. It is the same with the nerves which come from the renal plexus.

OPERATIVE PROCEDURES.

ON CATHETERISM AND CUTTING FOR STONE IN WOMEN.

A. Catheterism.—Catheterism may be practised with the patient lying down or sitting on the edge of a bed, the parts being covered or uncovered.

The catheter ordinarily used is the female one, generally carried in every pocket-case; it is usually made of silver and is short, its length being from six to seven inches. Slightly curved and designed to traverse a short and but slightly curved canal, it generally enters the bladder very easily. The only difficulty, if ever there is any, is to find the meatus urinarius. If the parts are uncovered, this difficulty does not occur. In the first case the patient lies on the back, the legs

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separation of the labia minora with the left thumb and middle finger, and raising the clitoris with the index finger, the nail of which remains turned towards the meatus urinarius; then carrying the point of the catheter on this nail, it is made to glide gently along the middle line from above downwards on the vestibule, and it then almost necessarily enters the urethral orifice

In the second case, which is the preferable, inasmuch as many women have great objection to manipulation of the clitoris, the surgeon, standing on the left, carries the index finger of the left hand, the pulp being directed forwards, towards the posterior part of the vulva. The finger meets successively with the fourchette, the vaginal orifice, and the urethral tubercle, ¼ of an inch from which is the orifice of the urethra; the finger thus serves to conduct the catheter, held in the right hand, which is directed along it to the urethra.

In performing the operation of catheterism in women it will be found much more convenient for all purposes to use a gum-elastic male catheter than the silver instrument advocated in the text. A good size is the No. 8 English, but other smaller sizes should be at hand. When the urethra is tortuous compressed, or elongated, the flexible instrument adapts itself readily to the distorted canal, and renders this sometimes troublesome operation much more easy to the surgeon, as well as less painful to the patient.

B. Cutting for stone.—This operation is but rarely practised on women, and it may be given as a precept, and before all indication of procedures, that it should not be resorted to without absolute necessity. Many reasons concur to render this operation infrequent. These reasons are the consequence of the fortunate anatomical disposition of the female urethra; its shortness, its want of curvature, and, above all, its great dilatability, which, joined to the declivity of the neck of the bladder, and the absence of the prostate, render easy the emission of calculi, when of small volume; or allow of their being easily seized and extracted when they have not acquired a very notable size.

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length into the vesico-vaginal wall. It has been practised by Fabrice de Hilden, Méry, Ruysch, and in latter times by MM. Faure, Clémot de Rochefort, Flaubert, and Rigal.

The process is very simple. Introduce an ordinary catheter into the urethra, the convexity looking downwards, and depress the vesical wall; a straight bistoury is then to be carried into the vagina, an incision made upon the instrument and enlarged to the desired length, care being taken to avoid the urethra.

M. Velpeau proposed a slight modification, which consists in placing the woman not in the ordinary position for vestibular lithotomy, but lying on the abdomen, the thighs and legs being opened and flexed.

Urethral operation (see Pl. LXXXI., fig. 3).—The different procedures of urethral lithotomy may be ranged under two principal heads: sometimes one or two lateral incisions are made into the urethra; sometimes the urethra is incised directly upwards or directly downwards.

If it is intended, after Fleurant and Louis, to incise the urethra bilaterally, the surgeon employs either the instrument of the latter, which is composed of a flattened sheath furnished with two lateral openings, into which a double-edged blade is introduced, and which cuts both ways, or, preferably, the double lithotome of Fleurant or Dupuytren, which are very analogous. If, on the contrary, a unilateral incision is preferred, for which M. Klein invented the name of *cystenchenotomy*, the section of the urethra is made obliquely from above downward and from right to left, by the aid of a grooved sound, which serves to conduct either a long straight bistoury, or, what is simpler, the lithotome of F. Côme. Lateral incisions are at present completely abandoned; meanwhile Dupuytren believed, and M. Velpeau inclines to the opinion, that the bilateral incisions may offer some advantage.

In the second method, the incision of the posterior wall of the urethra directly downwards has been proposed by M. Malgaigne, resembling a little vesico-vaginal lithotomy: this may be termed urethro-vaginal lithotomy.

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passed. Dilatation may be performed suddenly, as suggested by Tolet, or slowly, as first suggested by Douglas. First suddenly. The urethra may be dilated by introducing a grooved sound or a gorget, in the groove of which the finger is forcibly thrust, or by a bivalve or trivalve speculum. Secondly, slowly, by daily introducing into the urethra a tent of prepared sponge or gentian root, the size of which is progressively increased. The first process is frequently so painful that women cannot bear it; the second is therefore preferable, but it should not be pushed too far, for laceration of the urethra or permanent incontinence of urine may be produced. It should not be forgotten that the dilatability of the urethra diminishes with increasing age.

PLATE LXXXII.

OPERATIONS INVOLVING THE GENITAL APPARATUS PROPERLY SO CALLED.

OPERATIONS APPLICABLE TO RUPTURE AND FISTULÆ OF THE VAGINA.

Fig. 1.—This figure shows the state of the parts after perinæorrhaphy by Dieffenbach's method, modified by the substitution of the quilled suture for the twisted suture. *P*, anus; *u*, urethra; *v*, vagina; *i*, *i*, semilunar lateral incisions; *d*, *d*, *d*, threads tied around a quill; *c*, *c*, *c*, loops of thread round the opposite quill.

Fig. 2 represents the operation to remedy vesico-vaginal fistulae; it shows the fistula after paring the edges and while the sutures are being passed. *A*, cervix uteri depressed by tenacula, *t*, *t*; *B*, vesico-vaginal fistula, with the edges pared, and through which the end of a female catheter, *S*, introduced through the bladder by the urethra, *u*, is passed; *P*, anus; *b*, *b*, fingers of assistants separating the labia; *d*, *d*, *d*, sutures passed through the lips of the fistula; *c*, curved needle carrying a suture through the edges.

Fig. 3.—*Operation for vesico-vaginal fistula by adapat-*

tion of the edges of the fistula.—***Desault's method.***—**S**, **a support to bring nearer the edges of the fistula; *l*, *l*, labia minora** separated by the fingers of assistants, *b*, *b*; *u*, **meatus urinarius**; *a'*, edges of the fistula, **one of which is partly pared**; *a*, shred detached by the bistouri, *c*, **held by forceps.**

Fig. 4.—*Antero-posterior section.*—**To show the relation of** the parts concerned in the operation **for recto-vaginal fistula.**—*Method of M. Jobert.*—*V*, vagina: *b*, **bladder**, *c*, **vesico-vaginal** wall: *e*, rectum; *l*, upper lip of **the fistula drawn upon by a** thread, *l'*, the descent of **which is facilitated by lateral incisions**; *u*, meatus urinarius.

Fig. 4 *bis.*—*The same operation completed seen from the front.*—*l*, *l*, labia minora separated by the fingers of assistants, *b*, *b*; *u*, meatus urinarius; *a*, fistula; *c*, *c*, points of interrupted suture; *d*, *d*, *d*, threads of three other points of suture; *l*, upper lip of the fistula drawn down; *P*, anus.

Fig. 5.—*Operations for vesico-vaginal fistula by elytroplasty.*—*Method of M. Jobert.*—*P*, anus; *u*, meatus; *b*, *b*, fingers of assistants separating the labia; *a*, vesico-vaginal fistula; *l*, flap for closing it, taken from the skin of the buttock which hypertrophied clitoris, or one which has become the seat o any morbid growth, may be made by bistoury or scissors, the ligature may be rejected; the labia minora may be removed by excision or ligature. Excision by knife or scissors, or ligature of the clitoris or labia minora, is, ordinarily, not so satisfactory as removal by actual cautery, for in the case of excision bleeding is apt to be very troublesome, and with the ligature the tediousness and pain are both objectionable. Removal by écraseur does not altogether prevent hæmorrhage; and, all things considered, the actual cautery is decidedly preferable.

Lastly, more deeply situated tumours, vaginal tumours, require great precautions, and demand much attention on the part of the surgeon. Minute dissection is necessary in order to avoid, with certainty, wounding the walls of the canal in which he operates. If he has to do with a tumour situated in the recto-vaginal or vesico-vaginal walls, he should assist himself by rectal examination or catheterism. If a foreign body is introduced into the vagina, he must conform to the precepts given for extracting foreign bodies from the rectum, unless he prefers, where the foreign body is very large, dividing it, like Dupuytren, by introducing a small saw into the vagina, or, like Lisfranc, incising the perineum.

2. *Imperforate vagina.*—The vaginal orifice, in part normally closed by the hymen, is sometimes completely closed by this membrane. A small crucial incision with removal of the flaps suffices ; or, in default of instruments, when there is accumulation of menses behind the obstacle, with thinning of the partition, he may do as Malgaigne did, burst it by forcible pressure with the finger. If the partition is double, the operation may be repeated. But imperforation of the vagina may be due to congenital absence of a part of the canal, or to morbid adhesions. In the latter case generally the occlusion is incomplete, and well directed dilatation with sponge tents, aided, if necessary, by incisions, will be sufficient. In the former case, on the contrary, the canal may be wanting for a small portion of its length, and at the epoch of puberty, when the menstrual blood, accumulating at the bottom of the

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3. *Perinæorrhaphy* (PL. LX
name given to the operation by w

after having pared the edges with scissors or a bistoury, to keep them in apposition, either by suture a points passés, or better, by quilled sutures; or still better, the common interrupted suture; the patient is then placed on her back, the thighs are brought together immovably, and must not be disturbed except to draw the urine which the patient may not pass naturally, or for motions, which one should endeavour as far as possible to render easy and infrequent. If the sutures are found to drag too much on the edges of the wound, semilunar incisions, with the convexity outwards, may be made in the skin to the right and left of the sutures, after Dieffenbach's method.

Each incision should commence ½ an inch outside the posterior border of the labia majora, widening at its greatest convexity to ¾ of an inch, and finishing less than ½ an inch from the anus.

Deep sutures should be removed in fifty-six hours, but superficial stitches may be left in place until cicatrization is perfect; for the success of operation is likely to be lost by precipitation, or the rent may be replaced by a small fistula, which disappears with difficulty. One may often count on union by the first intention.

An operation for the restoration of the functional integrity of the anal sphincter in cases of rupture of the perineum into the bowel, suggested and practised by Dr. Wiltshire, deserves mention here. In addition to the ordinary operation of paring the edges of the ruptured parts, Dr. Wiltshire cuts down upon the retracted ends or stumps of the sphincter, the remains of which can be felt like a crescentic cord at the posterior margin of the anus, and in inserting the sutures he is careful to add an additional one, which picks up and reunites the separate ends of the torn sphincter, so as to restore the integrity of the lacerated ring.

A similar plan has been since advocated in a recent edition of Dr. Gaillard Thomas's work on the Diseases of Women.

As regards the material of which the suture is composed, opinions vary. The twisted silver wire suture is very manageable and quite reliable. To prevent the ends irritating the skin, a knot of gutta percha, softened by hot water, should be applied to each.

Pure silk, carbolized cat-gut, or silkworm-gut may be used.

OPERATIONS ON THE VAGINA.

1. *Vesico-vaginal fistulæ.*—This is not the place to enunciate at length the series of procedures which have been successively proposed to remedy a lesion which involves so painful and disgusting an infirmity. This useless trouble would only be, as usual, an indication of the poverty of sufficient means, or an indication of a great number of operations, all more or less inefficient, among which one may almost choose at hazard.

A lucky idea, ably put into practice by M. Jobert, allows us nowadays to do justice to old procedures, to relegate to the surgical arsenal numerous and varied instruments that henceforth can be of no service, as also to bear witness to the incessant efforts of modern surgery, to solace a misery formerly considered as beyond remedy, until J. L. Petit, and an actual cautery, or caustic (nitrate of silver generally) is applied to the edges of the fistula thus exposed. The caustic is either fixed in a straight caustic holder, or perpendicularly at the end of a long forceps. If the fistula is very small, it may sometimes be closed; generally it fails, and it may happen that, far from determining adhesive inflammation, an eschar is produced, which transforms a small canal into a large opening.

M. Vidal employed a sort of perinæorrhaphy; he proposed to close the vaginal orifice by paring the periphery of it and uniting it by suture; but as M. Sedillot stated, the vagina became an appendage of the bladder; and, admitting a complete success, the genital functions were abolished, and the woman exposed to other accidents, for the menstrual blood must of necessity arrive first in the vagina, and then rise up, after a longer or shorter sojourn, into the bladder, to be expelled by the urethra, the only possible issue of a cloacus which can never be completely emptied. Attempted twice, the operation has not been judged by its results, for in the first case it failed, and in the second the patient died. In judging it, then, even favourably, in admitting the complete obliteration of the vagina as possible, such an operation must be performed as a last resource, applicable only to cases of very considerable loss of structure, and in women who have passed the critical age.

There remain the method, or methods, of M. Jobert de Lamballe: elytroplasty, and cystoplasty by flaps.

Elytroplasty.—The first and oldest is an autoplastic procedure, which consists in closing the fistula by a cutaneous flap taken at the expense of the labia majora or the buttocks (see Pl. LXXXII., fig. 5).

The edges of the fistula, having been previously pared, are made tense, stretching the labium majus of the side from which it is proposed to cut the flap; then by two connected incisions an angular, or semi-lunar, flap of suitable size and especially long enough not only to close the fistula, but to resist retraction, is circumscribed. This flap should be cut so that the base or pedicle is as near as possible to the vagina. Sometimes the extent of the fistula may oblige the surgeon to

introduction; while deprive
posed to gangrene.

The flap is afterwards diss
the pedicle, which is left broa
to preserve its vitality. Then
traversed by a waxed thread,
with, and it is fixed by two su
certain difficulties, especially
in the vagina.

The operator begins by foldi
then, introducing a female cath
ing the end out by the fistula
thread are passed through the
then withdrawn, bringing with i
threads are then to be moderate
at the same time gently pushing
orifice, within the vagina, until
To fix it there the index finger o
to one of the angles of the fistul
conductor, a curved needle, or n
thread, is slid up; with one thru
the flap are traversed; then wit
out. It is then armed again wit
a similar suture is put in the oth
indispensable

have been left in the vagina so that they may be more easily found, begin to loosen; little by little the flap adheres more intimately to the lips of the fistula; but to avoid the chance of gangrene, M. Jobert advises that the pedicle be not cut before about the fourteenth day.

Side by side with this autoplastic procedure may be placed that of M. Gerdy, apparently much more simple, but difficult of execution, as are all the procedures of anterior sutures in cystoplasty. M. Gerdy dissects the vaginal mucous membrane of each lip of the fistula, then he brings the pared edges together and unites them by suture. In case of too great tension one may, as in perinæorrhaphy or hare-lip operations, make incisions in the mucous membrane a short distance from the flaps.

Cystoplasty.—The second method of M. Jobert rests essentially on the anatomical disposition already indicated, that is to say, on the relations which exist between the uterus, bladder, and peritoneum. It will be remembered that the vesico-uterine peritoneal cul-de-sac is shallower than the recto-uterine cul-de-sac, and that in consequence the cervix uteri and the posterior wall of the bladder are in immediate connection, and are united by lax cellular tissue, which allows of isolation of the two organs one from another to the extent of more than an inch. It is precisely that which has allowed M. Jobert to obviate the traction which causes cutting of the lips of the fistula by the sutures.

This operation necessitates a pretty complete list of instruments: thus a univalve speculum, tenaculum forceps, blunt-pointed and sharp bistouries, curved scissors, straight scissors, long and strong forceps, curved needles, the dart-shaped catheter of Lewsinsky or Deyber, sutures, a female catheter, one or more syringes filled with water, and sponges fixed on holders.

The instruments being arranged, the operation is begun. The patient is placed on her back with the legs separated. The surgeon depresses the lower wall of the vagina with the speculum so as to show the cervix uteri; and, directed by the index finger of the left hand, which he slides along the anterior wall of the vagina, he seizes the cervix uteri with the tenaculum forceps, sideways if the fistula is longitudinal; and in the contrary way if it is transverse, but always in such a manner as to leave the anterior insertion of the vagina on the cervix free. The forceps being fixed, the speculum is withdrawn and moderate traction is made on the cervix so as to bring it down as much as possible. Is it necessary to add that if the first pair of forceps do not suffice more may be used? When the cervix uteri is brought down it is well, before going further, to proceed to a last exploration of the fistula, either by introducing a sound through the urethra into the mouth of the fistula, or by injecting fluid through the urethra.

The great advantage of the last step of the operation is the bringing of the fistula almost under the operator's eyes. To obtain this result more completely, which is frequently wanting when the uterus resists the attempts to bring it lower, and especially to prevent the dragging which usually occurs on the upper lip of the fistula when the operation is finished, the vagina is detached from its insertion to the uterus by a semilunar incision made transversely; the cellular space which by the blunt-pointed bistoury. If the fistula is transverse one must begin at the posterior border, which, by reason of its position being lower, would be masked by the blood which would flow from the anterior lip. The paring should be through the whole thickness of the vesico-vaginal wall; and in cases when one meets with indurated tissues the operator must not be content with simply paring, but should remove them entirely.

The next process is to apply the sutures. To pass them M. Jobert often uses the barbed catheter of Deyber. But the management of this instrument is somewhat complicated and it is not indispensable. When the fistula is pared the wound is generally large enough to allow the finger being passed into the bladder and guiding the needle. The operator should always prefer this method, which has the advantage of greater simplicity, and, above all, allows him to assure himself that the needle has traversed the whole thickness of the wall, which is sometimes great. The needle then, armed with the suture, is introduced into the bladder, then it is brought through the other lip, from the bladder to the vagina; and the same manœuvre is repeated as many times as it is judged necessary to insert sutures. If too great obstacles compel the operator to use the barbed catheter, he introduces it through the urethra into the bladder so as to bring the end to one of the lips of the wound, then, pushing the barb armed with the suture, he traverses this lip, disengages one of the ends of the suture, and retiring the barb in its sheath, he does the same to the other lip, and thus has the two ends of the suture hanging outwards. In these two cases the two lips of the fistula are comprised in the loops, the number of which is proportional to the extent of the fistula. The two ends of the suture are lightly drawn to approximate the two lips of the wound, then they are only lightly tied, so as not to cut the flesh, for fear of exciting too sharp inflammatory reaction. It may happen that the anterior lip is the seat of some dragging; it is good in that case to combat its effects, to practise some small incisions in the vaginal mucous membrane parallel to the lips of the fistula. If the operation has been well done, if the lips of

it becomes time to remove
are withdrawn, a catheter is
patient is removed to her bed.
Jobert's example of placing a
there is no fear of hæmorrh
flow, the means which serve
vagina will always suffice : it
overcome by injections of cold

At the end of eight or ten d
cicatrization is sufficiently ad
the sutures : the uterus is low
which hang in the vagina, the

When the sutures are remo
diminished, and not cured. In
tion, or better, a fresh suture,
necessary to operate more than

The vagina may be the sea
which operative surgery propos
that a more or less extensive
recto-vaginal septum constitut
sometimes one sees a commun
portion of the intestinal tube
vagina: an entero-vaginal fistul

(*a*) *Recto-vaginal*

imitate Saucerotte, who, having failed by the suture, transformed the fistula into a rupture of the perineum and septum by an incision of the lower part of the recto-vaginal septum and had recourse to perineorrhaphy.

(*b*) *Entero-vaginal fistula.*—As regards the treatment of entero-vaginal fistulæ, in which the continuation of the intestinal channel becomes more or less obliterated, surgery offers but few resources. Two operations of this kind have been attempted by two different processes; in both cases the patients died. In the first M. Roux incised the abdominal wall, and after having attempted to separate from the vagina the portion of intestine which communicated with it, he wished to invaginate it in a loop of intestine which he believed to be below the fistula. At the autopsy it was found that instead of invaginating the portion of intestine, which was the seat of the fistula, in the lower end of the colon, it had been made to communicate with the gut above the level of the fistula. In the other case, M. Casamayor devised the following much more simple and also less dangerous process.

The operation was performed with the aid of a particular apparatus, a kind of enterotome, composed, like that of Dupuytren, of two stems articulated like forceps, eigh inches long, each furnished with an oval plate, ¾ inch long and half that breadth. One of these two stems introduce into the vagina was carried through the fistula to the uppe end of the intestine; the other was conducted through th rectum to the level of the first. The two plates were then only separated from one another by the thickness of the opposed walls of the intestine and rectum. By the two faces, which should correspond, the plates offer some indentations designed to maintain its relations more securely. Then, the two branches being approximated, the intestinal walls are strongly compressed. By the aid of this constriction it is sought to produce a loss of substance, which, putting in communication the two portions of intestine, allows the fæces to follow the new passage. It is to be regretted that pneumonia carried off the patient, and rendered useless a well-conceived operation.

PLATE LXXXIII.

OPERATIONS APPLICABLE TO THE TREATMENT OF UTERINE POLYPI AND PROLAPSE OF THE WOMB.

Fig. 1.—*Ligature of a polypus.*—*A*, polypus ; *b*, gorget held by an assistant to separate the polypus from the vaginal wall and help the action of vulsellum forceps, *d*, and at the same time to facilitate the passage of the ligature, carried round the pedicle, *c'*, by the knot fastener ; *u*, the meatus urinarius ; *b'*, fingers of an assistant ; *P*, anus.

Fig. 2.—*Torsion of a polypus.*—*A*, polypus ; *B*, bivalve embracing the pedicle of the polypus ; *P*, anus ; *u*, meatus ; *c*, torsion forceps.

Fig. 3.—*Excision of a polypus.*—*A*, polypus ; *P*, anus ; *l*, *l*, labia separated by the fingers of assistants, *b*, *b'* ; *u*, meatus ; *t*, *t*, tenaculum forceps, which draw upon the polypus, the pedicle of which is partly cut through by strong scissors.

controls the communication between the vaginal ball, *B*, and the external ball, *B'*, which is emptied on being compressed to distend the other.

OPERATIONS UPON THE UTERUS.

Operations applicable to uterine polypi.—This is not the place to enter upon extended anatomico-pathological considerations of uterine polypi; these do not in effect decide the surgeon in preferring one method over another; he relies more upon the indications furnished by the consistence and volume of the morbid product, and, above all, he is careful to ascertain if it is pedunculated or not.

OPERATIVE PROCEDURES.

There are at least six methods of operation which have been proposed for the cure of uterine polypi. Of these six methods three are very seldom employed; they are cauterization, crushing, and torsion. The other methods—avulsion, ligature, and incision—are more important.

(*a*) *Cauterization* was known to the ancients; it is nowadays nearly abandoned. The operative procedure is the same as that which will be described *apropos* of cauterization of the cervix uteri; it is done with the actual cautery or caustics.

(*b*) *Crushing.*—Having to do with a small polypus of soft consistence, Récamiér introduced the finger into the cavity of the cervix uteri, and it was sufficient to press the polypus between the cervical wall and the bulb of the finger to break up and extract it. In a similar case this example might be imitated. One may also, if the polypus is very voluminous, but appears soft, have recourse, not to a real crushing, but to a strong compression with forceps to diminish the volume somewhat, as Dupuytren and Récamiér once did, causing almost complete disappearance by combining pressure, crushing, and avulsion. It was a large polypus, consistent, which could not be lowered by any means. These surgeons broke it up several times with tenaculum forceps and the fingers, so as to make it a pulp, which suppuration was left to eliminate.

(*c*) *Torsion.*—Like crushing, torsion is hardly anything else

if it is hard, a
very small, it resists, and it
twisted, but the whole uterus

(*d*) *Avulsion.*—Avulsion is
reserved for polypi which are
is passed into the vagina, th
polypus forceps are slid alo
seized, and partly by traction
times entirely torn away, ge
latter case the forceps are agai
are renewed until it is all extra

M. Malgaigne indicates an
multiple polypi, viz., drawing d
forceps, then, with a curette
cavity, scraping all the interna
cedure which partakes of crush
author, the advantage of not bei

(*e*) *Ligature* (Pl. LXXXIII.,
tied outside the vulva, in the va

1. If the tumour appears outsi
the operation is very simple, an
pedicle with a strong waxed t
double knot. If the pedicle do
drawn down by tenaculum force
too large for a simple ligat

a hole at one end, or ending, as proposed by Mayor, in crabs, claws, to receive the thread, or two metallic tubes which carry a thread. The patient is placed as for the operation for stone or vesico-vaginal fistula; an assistant presses on the hypogastrium, the surgeon explores the vagina with the two first fingers of the left hand, feels the polypus again, then, applying these two fingers to the posterior wall of the vagina, they serve as conductors to guide the knot fasteners and place the ligature round the pedicle. The fingers are withdrawn, and a knot fastener is grasped by each hand; they are made to describe a half-circle from behind forwards, and the pedicle is surrounded by a loop of ligature. One may equally well, like Desault, engage the two knot fasteners in front, and, while one remains immobile, manage the other so as to surround the polypus. In these two cases, the instruments, being carried in front, are crossed, and thereby the two ends of the ligature are crossed; then, after having withdrawn the instruments, recourse is had to a knot holder (that of Græfe or Sauter), which twists the ligature on itself several times so as to strangle the pedicle.

3. Lastly, if the polypus is retained within the uterine cavity, recourse is had to the process of ligature with knot fasteners. But a difficulty here presents itself: in carrying a ligature around a polypus within the uterus, there is danger of tying the cervix uteri itself. This operation is often accompanied by sharp pains and accidents which oblige one to relax the ligature, and even to renounce it.

Instead of making use of silk for a ligature, silver wire may be employed, which, being readily twisted, avoids the necessity of tying a knot, a proceeding always accompanied with considerable difficulty.

(f) *Excision.*—Like the ligature, excision of uterine polypi may be practised in the vagina or in the uterus. For the rest, whatever the place where the operation is performed, the process varies but little. The patient is always placed as in the preceding cases, and the surgeon introduces into the vagina either a bivalve speculum, or rather the index finger of the left hand, to serve as a guide for seizing the polypus with tenaculum forceps, by the aid of which he draws it down as low as possible, facilitating the lowering if necessary by the use of other forceps placed higher up. The polypus having descended, the pedicle is apparent, and it is then cut with a bistouri or with strong scissors curved on the flat (Pl. LXXXIII., fig. 3).

If the polypus offers too great resistance to efforts at traction, and cannot be brought down, a long blunt-pointed bistoury curved on the flat is to be slid along the finger, and the pedicle cut in the vagina. It is scarcely necessary to remark that this process is only applicable to polypi already large, fibrous polypi; for if we have to do with a small polypus, it suffices to dilate the vagina by a speculum, discover the tumour, and apply the bistoury or scissors to its root.

When the polypus is retained within the womb, it must be brought down in the same way; or better, the uterus may be drawn down by forceps placed in the cervix, and then the polypus itself dealt with. Sometimes the polypus is too voluminous to pass the cervix uteri or vagina, it is then [redacted] great majority of cases. The wire écraseur is very convenient and can be applied without difficulty, even to large polypi. That form of wire écraseur should be used which allows of the adaptation of the wire around the polypus before it is attached to the rest of the instrument. In this way a loop of wire of moderate length may be made to encircle the base of a polypus or sessile growth. When the pedicle is properly encircled by the loop of wire, the ends are to be attached to the handle of the instrument and the screw put into motion. In this way the wire is caused to embrace the pedicle so tightly that by slow turns of the screw the tissues are gradually cut through quite cleanly, and that without loss of blood. Hæmorrhage from the pedicle is thus prevented, and the risk from that source is accordingly almost entirely excluded. The process is quick, clean, simple and safe. The instrument can be applied to polypi even high up in the uterus.

The application of the écraseur will be facilitated by first seizing the polypus by polypus forceps, or, if the growth be too large for that, by toothed forceps. The handles of both these instruments should lock, so that a firm grip may be obtained with them without the necessity of maintaining constant pressure by the hand. Downward traction to a sufficient extent may be made by the forceps, and the wire, rope, or chain of the écraseur, can then be readily applied around the pedicle or base of the growth.

OPERATIONS THE OBJECT OF WHICH IS TO REMEDY PROLAPSE OF THE UTERUS AND VAGINA, VAGINAL CYSTOCELE AND RECTOCELE.

These operations are of two kinds—palliative and radical. The palliative treatment is the application of pessaries. There are many kinds: bung-shaped, hour glass-shaped, ring-shaped, cup-shaped, etc., etc., the form of which varies not only according as one proposes to combat prolapse of the vagina, vaginal herniæ, falling, or the various displacements of the uterus, but also as the inventors of the different instruments were moved by such or such principles; one proposes to act on the cervix uteri, another on the body of the uterus, another solely on the vagina, which he proposes to stretch, etc. For the rest one can readily conceive that the size of the vagina, or still more the nature of the lesion, must singularly modify the form of pessary. One can therefore frequently employ with great advantage indiarubber air pessaries, which by their small volume are very easy of introduction, and which are moreover much more capable of filling the vaginal cavity in dilating and unfolding the folds of the vagina, or the organs which tend to escape from that canal, without causing discomfort comparable with that almost inevitably caused by all others, their size and consistence being augmented, but not their weight. Their action is double: they keep up the organs by direct pressure, they dilate the vagina, causing its folds to disappear, which causes the organs to rise, obliging them to resume a normal position (Pl. LXXXIII., fig. 5).

Whatever may be the pessary chosen, it is first oiled and then is carried to the entrance of the vagina and is introduced from before backwards, and from below upwards. If the disheartening facility in spite of all the more or less troublesome means with which they are complicated to obviate the defect. In this relation, too, pessaries of caoutchouc, funnel-shaped, and especially air pessaries, have a great advantage, for they keep themselves in position.

The *radical cure*, like the palliative treatment, is also encumbered with far too great a number of processes, the efficacy of which is no more demonstrated than that of different pessaries. Thus Dieffenbach proposed the excision of some folds of the vaginal orifice; Marshall, Ireland, Hemming, and Velpeau that of a longitudinal or quadrilateral flap of vaginal mucous membrane; M. Langier prefers to cauterise it; then M. Malgaigne thought to obtain good results by excising the demi-circumference of the vaginal orifice, before and behind, and reuniting them by suture. Fricke (of Hamburg) indicated, under the name of episiorrhaphy, vivification of the labia majora, and then reunion by suture. Lastly, M. Romain Gérardin had recourse to the extreme process applied by M. Vidal (de Cassis) to vesico-vaginal fistulæ, obliteration of the vagina.

All these processes are so simple as to render a description of them useless; but, unfortunately, they offer the common inconvenience of being inadequate.

All fail against an obstacle which is almost insurmountable: and, even when they seem to be followed by complete success, one is often deceived, for the malady is not slow of reproduction.

In cases where pessaries have to be applied to combat falling of the vagina, or womb, or displacement, it is evident that the application of the pessary must be preceded by another little operation, the reduction of the fallen or displaced organ.

To reduce displacement of the vagina, the plan is the same as for prolapse of the rectum: the surface of the projection is covered with a napkin smeared with grease, and then gently pressed with the fingers from the circumference towards the centre. It is the same for the reduction of the uterus: the organ is enveloped in greased linen, and then pushed back by compressing the fundus so as to lessen its size; if the organ

, then, having re
employment of an appropri
Simpson's sound.

Serious difficulty may be e
verted uterus to its proper posi
impossible, and then, if hæmo
patient, amputation of the inve
sary. Success will often atten
elastic pressure should be kep
fundus uteri, with slight deviati
pression of the organ by an el
driving as much of the blood as
order to reduce the bulk of the b
all efforts at restoration. Inci
have been practised by some in
the neck. These should be care
to avoid undue laceration, or pe
cavity or adjoining viscera, *e.g.*,
more serious measure has been
abdominal cavity, dilatation of
aspect, and subsequent reinversio

This is so grave an operation t
be guarded by great circumspecti

All attempts at reduction are n
success if they are made a

PLATE LXXXIV.

OPERATIONS ON THE CERVIX UTERI AND OVARIES.

Fig. 1.—*Tapping the uterus.*—*a*, uterus; *b*, bladder; *c*, rectum; *d*, index finger of the surgeon introduced into the vagina, and serving as a conducter of a trocar, *d'*; *e*, sacrum; *f*, abdominal wall depressed; *g*, loops of intestines; *h*, anus; *i*, urethra; *l*, orifice of the uterus.

Fig. 2.—*Application of the speculum.*—*a*, *a*, trivalve speculum; *b*, cervix uteri.

Fig. 2 *bis.*—*d*, long forceps, with cotton wool, *c*, to cleanse the cervix.

Fig. 3.—*Cauterization of the cervix uteri.*—*a*, ivory speculum; *a'*, its handle; *b*, cervix uteri; *c*, actual cautery; *c'*, its handle; *d*, *d'*, labia majora.

Fig. 4.—*Puncture of an ovarian cyst.*—*a*, cyst; *b*, canula of trocar, the handle of which is seen at *c*; *d*, uterus; *e*, *e'*, Fallopian tubes; *f*, healthy ovary; *g*, bladder; *h*, coils of intestine.

EXPLORATION OF THE CERVIX UTERI.

Of the touch.—Besides palpation and mediate auscultation through the abdominal parietes, the surgeon has at his disposal two modes of direct exploration to discover the different physiological and pathological conditions which the uterus and vagina may present. By touch he acquires a number of ideas respecting the consistence, volume, etc., of the cervix and body of the uterus, and by the application of the speculum he completes it by bringing in the aid of vision.

Vaginal examination may be made in two ways, the patient standing or lying down.

1. If the woman who is to be examined is standing, she is to be placed with her back against a firm substance; the surgeon sits or kneels before her; kneeling on the left knee, if he uses the right hand, and *vice versâ.*

the vulval opening
gently and without violence.
its nature is to be investigate

It is always to be understoo
the integrity of the hymene
unless there be urgent indicati

The vagina having been e
cervix uteri, and glides gently
surrounding parts—in a word,
direction, examines the uterus
bility, consistence, temperature
plete the investigation, the su
the hypogastrium and depresses
fixes the uterus with the finger
compress the organ between the
the greatest certitude its form a

This last stage of the examina
tised when the patient is lying d
completed, the nature of the
should be carefully examined.

2. The patient lying on the
pelvis being somewhat raised an
abdominal walls in the greatest
the surgeon places himself as ne
and passes his hand under th

logical practice. In England the patient is usually placed on her left side for both purposes.

Application of the speculum.—Before proceeding to the application of the speculum, the surgeon always finds it a great advantage to make a digital examination. He learns by this means the exact position of the cervix uteri, and thus avoids a number of searchings which render the operation fatiguing, difficult, and sometimes even nearly impossible.

It is unnecessary to insist on the different form of instruments which may be used; the operative procedure varies but little whatever be the speculum preferred.

It is, however, worthy of remark that the smaller the inferior extremity of the speculum, the easier it is of introduction; and in this respect the bivalve speculum apparently offers the greatest advantage by its conical shape; when introduced, the examination is often difficult, the separation of the two valves permitting the folds of the vagina to project into the cavity of the speculum, and to mask the parts which one would examine at the top of the vagina. In this respect it is more convenient for the examination of the vaginal wall.

The quadrivalve speculum is very rarely employed; those which are preferable are the full speculum, that is to say, the slightly conical metal tube of Récamiér, furnished at the end with the ebony of Galezowski, or Mélier, or the trivalve speculum.

The patient is placed on the edge of a bed, the lower limbs separated, bent, and supported by assistants, or on chairs; the surgeon places himself in front, either seated or kneeling on one knee, takes the speculum, previously greased, and, separating the labia with the fingers and thumb of the left hand, presents the end of the speculum to the vaginal orifice, and gently introduces it. The instrument ought in the first place to be directed from before backwards, and but little from below upwards, so as to avoid the fourchette, which if pressed upon causes much pain. The orifice passed, the hand is lowered, and the instrument is introduced in the direction of the vaginal axis. The plug is then to be withdrawn, and the introduction is to be continued with much gentleness, guiding the speculum to the position of the cervix uteri, which has already been recognised by touch. At the same time the operator examines the state of the vaginal walls, against which he must exercise a certain amount of force to overcome their resistance. In effect the patient involuntarily makes efforts, the vagina contracts and presents a rose form at the extremity of the instrument, which may often be taken by the surgeon for the cervix uteri, but it has not the smooth aspect of the cervix; on the contrary, the surface is furrowed with corrugations somewhat redder than the cervix in the normal state, or paler in case of inflammation of the cervix. Lastly, it does not offer the resistance of the cervix on pressure, either by the speculum or sound.

As soon as the cervix appears endeavours should be made to engage it in the orifice of the speculum; if it is too large, the different parts should be examined by inclining the speculum from side to side, the parts successively discovered being wiped by lint or cotton wool, held by long forceps (see Pl. LXXXIV., fig. 2 and 2 *bis*).

In the case of pronounced uterine deviation, anteversion, or retroversion, the first thing is to reduce it. Reduction is ordinarily easy; but the displacement may be reproduced directly. It may be done by the vagina, or by the rectum. The patient lying down, and the abdominal walls in a state of relaxation, the surgeon introduces one, or, if required, two fingers, by means of which he first pushes up the body of the uterus, and then hooking the end of the finger on the cervix, he tries to bring it downwards.

If that be not sufficient, the body of the uterus may be pushed up through the rectum, either by the fingers, or, rather, after Evrat, by means of a stem nine or ten inches long, having at its end a greased plug, whilst attempts are made by the vagina to hook down the cervix.

Lastly, when these attempts have failed, and the displaced uterus is distended by the product of conception, a last resource is puncture of the organ.

Puncture of the uterus.—Puncture of the uterus is done in cases of congenital or accidental obliteration of the cervix, either to give exit to the menstrual blood accumulated in the uterine cavity, or when the gravid organ is in a state of retroversion which cannot be modified. In the first case the puncture is made per vaginam; in the second it may also be made by the rectum.

1. By the vagina (Pl. LXXXIV., fig. 1), the finger in the canal serves the surgeon to recognise the point where the os and cervix should be. Should this search be fruitless, it at least serves to guide a slightly curved trocar, so disposed that when the handle of the trocar is held in the palm of the hand, the point is within and masked by the canula.

When the end of this reaches the point which it is judged suitable to traverse, the instrument is thrust through, being stopped as soon as resistance is no longer met with. The trocar is then withdrawn, and the liquid evacuated through the canula, or, if desired, a sound may be inserted to keep open the orifice made or to inject into the uterine cavity.

2. By the rectum the process is the same; instead of introducing the trocar by the vagina, it is conducted through the

rectum; and as, in this case, the object is especially to determine the escape of the liquor amnii, should it not flow, a stylet may be passed through the canula, so as to ascertain the nature of the obstacle, and to learn whether or no a second puncture should be made.

Puncture of a retroflexed or verted gravid uterus is rarely, if ever, necessary. Evacuation of the bladder and rectum, the prone, or genu-pectoral position, and chloroform will always, or nearly so, enable the surgeon to restore the displaced organ.

A word may be added respecting the reduction of displacements of the non-gravid uterus.

When reduction cannot be effected by the fingers, the careful use of the uterine sound will usually accomplish it: that is to say, if there be no morbid adhesions of the uterus to surrounding parts. In a case of retroflexion, for example, the sound should be bent to a curve, corresponding, as nearly as the operator can judge by digital examination, to the bend in the uterus. The sound being then introduced into the uterine amputation. Ligature, being frequently followed by very grave accidents, is completely abandoned. Excision, extolled by Récamiér and Lisfranc, is, like all other operations for cancer, followed by such numerous relapses that, conjoined with the series of primary accidents which may accompany it, it is nowadays almost abandoned. Cauterization justly merits to be reserved.

Cauterization of the cervix uteri, which is also practised for several other lesions besides cancer of the cervix, is a very simple operation.

Apply the speculum, cleanse the cervix, place between the posterior lip and the wall of the speculum a dossil of dry lint, so as to absorb such portions of the caustic as, failing to act on the cervix, may involve the vagina; then, by means of forceps or caustic holder, apply the caustic, solid or liquid, to the cervix, and let it remain there a longer or shorter time, according as it is desired to affect the tissues slightly or deeply; lastly, apply some cooling lotion: this is the whole procedure.

If, on the other hand, the actual cautery is preferred, and this is a procedure one need not fear to recommend, several lenticular cauteries are heated to a white heat, so as to act as deeply as may be desirable; then an ivory speculum is to be applied, in order to avoid burning the vagina and causing pain; or even a tin speculum, after M. Malgaigne's example.

Cauterization, and especially with the actual cautery, is an excellent operation; generally but slightly painful, it permits of the destruction, if not by one by several applications, of the deep ulcerations, which at first sight one might have felt obliged to regard as of a nature to yield only to a cutting instrument.

Amputation of the cervix uteri.—This is performed in two ways, according as the womb can be lowered or not.

1. Two fingers in the vagina serve to implant and keep in place tenaculum forceps, by means of which the uterus can be brought down to the level of the vulva; then, with a blunt-pointed curved bistoury, protected with lint up to near the end, section of the tissues is made, care being taken always to keep above the diseased portion, and to trench on the sound parts.

2. If traction will not produce the desired effect of lowering the womb, scissors, curved on the flat, may be advantageously used, or Dupuytren's curette, which should be introduced into the cervix, guided by the two fingers.

The operation is generally done without the patient having felt much pain, except perhaps during efforts at traction, which should always be done with extreme gentleness and slowness; blood will flow freely, but it need not occupy the attention much, plugging being called for only when the flow is very abundant and the patient is sensibly weakened by it.

Dr. Marion Sims has lately practised an operation similar to the second of the above. He cuts widely into the sound tissues and plugs the resulting cavity with a styptic preparation of iron—the persulphate by preference, or the perchloride. Care should always be taken in these operations not to invade or encroach too nearly upon the peritoneal cavity or the bladder or rectum.

The cervix may also be removed by means of the écraseur.

Extirpation of the womb.—Extirpation of the womb is, even mon, and do not communicate with each other. This variety in the disposition of the cyst has real interest for the surgeon: though it is not always possible to know whether the cyst is uni- or multi-locular. Sometimes the cyst contracts intimate adhesions with the neighbouring organs; at others it is found to be retained only by a pedicle formed by the Fallopian tube and the broad ligament in which arteries, and notably the ovarian artery, are found, the development of which has followed that of the tumour.

OPERATIVE PROCEDURES.

For this lesion a simple operation is generally adopted, but one which is incomplete in its results, for it only affords temporary relief, and generally does not prevent the reproduction of the disease. This operation is *puncture* of the cyst (Pl. LXXXIV., fig. 4.) Puncture, like that which is made in dropsical ascites, is made with a trocar through the abdominal wall, care being taken to carry the instrument through the most prominent part of the tumour, generally in the median line. Puncture has also been made through the vagina, but the results of such attempts are not such as to encourage a repetition. Purely palliative, puncture is only useful in uni-locular cysts; it may, however, be repeated many times. It may even sometimes, according to Ledran, cure radically, a result the rarity of which is much to be regretted when one compares the freedom from danger of the process with the dangers presented by all the other curative measures of which we shall have to speak.

It is not on account of the smallness of their number that one may reproach these methods: in effect there are many but all so inefficient or dangerous that the palliative cure is, and perhaps long will be, the only treatment a really prudent surgeon will first think of. Accordingly we shall be brief respecting these different methods.

We shall, therefore, merely refer to the compression of M. Bricheteau, by means of a tightly laced bandage; puncture with a small knife, proposed by M. Maisonneuve, with a view to the escape of the fluid into the peritoneal cavity, a method which may well bring about a fatal peritonitis; puncture with a canula, which is left in to allow of the continuous escape of the liquid, a practice which has succeeded in South Carolina, but which in the hands of M. Robert, less fortunate than the American surgeon, Douglas, caused hectic fever and endangered the life of the patient.

As regards the tapping of cysts, experience shows that when judiciously done it is usually harmless. This simple operation is moreover often of great aid in diagnosis, the microscopical and chemical characters of the fluids withdrawn frequently affording conclusive evidence of the nature of a given case. Again, cysts of the parovarium, which are usually single and contain limpid fluid of low specific gravity, are commonly cured by a single tapping. On the other hand, true single ovarian cysts generally refill, but immense relief may be gained by a simple tapping, which may, in some cases, be repeated scores of times.

Tapping followed by the injection of iodine has long since been discarded by the most experienced and enlightened ovariotomists. The results are generally most unsatisfactory with which the incision can be enlarged. The surgeon introduces one or two fingers, or even the whole hand, through the wound, to recognise the nature and number of adhesions, and (it is to be regretted) it may happen that after having produced a large separation, he may be obliged to give up the operation when the adhesions are so strong that he could not think of destroying them. In this case the cyst is emptied and becomes one of simple incision. When the adhesions are few a ligature is put around them and they are cut. The cyst, being isolated, is incised or punctured to give exit to the fluid; then the pedicle is included in a strong ligature, and the tumour can be removed.

Modern surgery deals almost as, if not equally, successfully with dermoid as with simple cysts of the ovary. Any competent ovariotomist can ordinarily diagnose the character of the tumour, whether mono- or poly-cystic. Indeed much more than this is requisite, and can be done; for before operative measures of so grave a character are undertaken it is usual, in this country at least, to make a differential diagnosis between the various forms of abdominal tumour; at any rate such as may, or do, simulate ovarian tumours.

The brilliant results of ovariotomy in England and America show that it is an operation more successful than almost any other capital operation in surgery. The mortality in the hands of Wells, Keith, Atlee, Peaslee, Wiltshire, and other operators is now less than twenty per cent: indeed the most recent statistics would make it only ten per cent! Great improvements have been made in the manner of operating, and especially in the after treatment of the patients. Scrupulous cleanliness is observed, all possible sources of infection are avoided, the peritoneal cavity is carefully freed from all clots of blood or other discharges, and the pedicle is more judiciously managed than formerly, being more frequently clamped than it used to be. Coincidently with these improvements the mortality has fallen to the remarkably low figures already mentioned.

In performing the operation of ovariotomy the best operators are careful not to make a larger incision into the abdominal parietes than is requisite; but they do not hesitate to make it free enough for convenience of manipulation, nor to enlarge it if judged necessary, for it is found that mere length of incision alone does not unfavourably influence the results of the operation. Care is taken to arrest bleeding step by step; adhesions being ligatured when necessary with pure silk or carbolized catgut. The cyst or cysts are tapped to reduce their bulk before withdrawing the tumour through the abdominal incision; and the pedicle is dealt with according to the indications: *e.g.*, if it be long enough the most experienced operators, as Wells, put a clamp upon it; if short it may be tied in one or more portions; but it is always important that the ligatures should transfix the pedicle so that slipping may be avoided. Care should of course be taken not to wound large blood-vessels when transfixing the tissues. Some operators prefer searing off the pedicle with the hot iron, the tissues being held meanwhile by a suitable clamp. However the pedicle may be secured, care should be taken to prevent the occurrence of hæmorrhage from it, cases having terminated tent, *B*, into the cervix uteri; *u*, meatus; *f*, intestinal loops; *r*, cavity of the catheter.

Fig. 1 *bis.—The catheter and the stilette.*

Fig. 2.—*A*, uterus; *A'*, vesico-vaginal septum. The sponge tent, *B*, has swollen and dilated the cervix; *r*, double thread serving to withdraw the tent; *f*, loops of intestine; *b*, bladder; *u*, meatus; *c*, vesico-vaginal septum; *V*, vagina.

Fig. 3.—*Plugging.*—*A*, uterus; *B*, plug of lint introduced into the vagina, and pushed up to the cervix by two fingers of the operator's right hand, *D*; the left hand, *F*, retains externally a double thread, *e*, attached to the plug; *f*, loops of intestine; *b*, bladder; *u*, meatus; *c*, vesico-vaginal septum; *d*, recto-vaginal septum; *e*, rectum.

OPERATIVE PROCEDURES.

Perforation of the membranes.—Practised by Macaulay in 1756, this operation may be done either with a straight or curved trocar, but it should be long enough to penetrate into the interior of the cervix and reach the inferior segment of the membranes. The instrument should be so directed as not to wound either the mother or the fœtus.

After the puncture the rapid flow of fluid is followed by contractions and expulsive pains.

The method may prove dangerous both to mother and fœtus. After the complete escape of the fluid, labour may begin late and proceed slowly. The uterine walls then compress the fœtus and cause its death.

A much more safe and satisfactory method of inducing labour is that which consists in merely introducing a clean (new, preferably) gum-elastic catheter into the cavity of the uterus, where it is to be allowed to remain until regular contractions are established. The instrument should be gently passed up, *without the stilette*, between the membranes and the uterine wall, the whole being introduced into the uterine cavity, with the exception of about a couple of inches which should be coiled up in the vagina. All things considered, this is probably the safest method of inducing labour prematurely.

Meissner's process.—With the view of moderating the flow of the amniotic fluid, and to prevent unfortunate consequences, Meissner (of Leipsic) has proposed the perforation of the membranes at the highest part of the ovum. For that purpose a silver canula 13 inches long, of which the curve represents an arch of 8 inches radius, is armed with two stilettes: one, ending in an ivory button, facilitates the introduction of the instrument; the other, ending in a trocar, serves to make the puncture. The canula is introduced between the posterior wall of the uterus and the membranes. When it has reached some height above the cervix, the bulbed stilette is replaced by the trocar and the puncture is made. The flow of the fluid then slowly occurs; the pains have time to come on; dilatation begins before the fœtus is compressed by the uterus, and delivery may take place in thirty-six or forty-eight hours.

Plugging (Pl. LXXXV., fig. 3).—Schœller, of Berlin, has practised plugging of the vagina with the view of provoking premature delivery. Whatever the object for which plugging is had recourse to the method of its performance is the same.

The rectum and bladder are first emptied, then a plug comntroduced into the cervix with long forceps, and then applied a plug to keep the tent in place, which, in dilating, brought on contraction.

Ordinary process (Pl. LXXXV., figs. 1 & 2).—A small cylinder of prepared sponge, traversed by a loop of thread, is placed in a canula (fig. 1 *bis.*) ; the two forefingers of the left hand are then introduced into the vagina, and feel the position of the cervix ; the canula is then slid along the palmar aspect of the fingers to the os uteri, in which the end of the instrument should be engaged, when, the stilette being pushed, the sponge slides into the cervix, and the canula is withdrawn.

The first sponge determines, by its dilatation, pains which soon cease ; the dilated cervix will then easily receive a second tent larger than the first ; fresh pains occur, and the dilatation of the cervix increases, and if labour does not progress regularly, a third tent may be inserted, and the cervix still more dilated, so as definitely to bring on labour.

It is important that only such tents be used as have been fully disinfected by steeping them in thymol, carbolic acid, or some other powerful disinfectant. No tent should be allowed to remain *in situ* over twelve hours, and disinfecting injections should be used before another tent is inserted. Barnes's bags may be substituted for tents when the cervix uteri is large enough to admit the smallest size.

Process of uterine injection.—M. Cahen describes this process as follows :—

To practise the injection use is made of a small syringe, generally of tin, containing from forty-eight to sixty grammes of starch water. The canula is about 9 inches long, ⅛ to ⅙ in diameter at its extremity, and presents a curve similar to that of a female catheter. The patient should lie on her back with the pelvis raised ; two fingers should be passed to the posterior lip of the os, and along them should be slid the canula, which should be introduced between the anterior wall of the uterus and the ovum to the extent of 2 inches within the uterine cavity. The injection is then to be begun, being thrown in gently and slowly, care being taken to raise the syringe a little, to avoid the opening being applied to the uterine wall, and to vary, if desired, the direction of the instrument, whenever there is any obstacle to the escape of the liquid. The syringe is withdrawn gradually; ten minutes after the patient may get up and walk about; if at the end of six hours there are no signs of labour, the injection may be repeated.

PLATE LXXXVI.

CÆSARIAN SECTION.—SYMPHYSEOTOMY.

Fig. 1.—*Body of a pregnant woman.*—*a, a'*, line indicating the lateral incision; *b, b'*, line indicating the median incision.

Fig. 2.—*Cæsarian section practised in the linea alba.*—*a*, head of the child; *b, b'*, incision; *c, c'*, operator's hands; *d*, flap of membranes.

Fig. 3.—*Lateral incision.*—*Extraction of the child by the feet.*—*a*, body of the child; *a, a'*, incision; *c*, hand of an assistant separating the lips of the wound; *d, c'*, hands of the

OPERATIVE PROCEDURES.

The incision may be made laterally, *a, a'*, fig. 1, on the right side following a line springing upwards from the anterior superior iliac spine to the last rib. The incision thus practised has been recommended by some authors with the object of avoiding the recti muscles.

But M. Malgaigne has justly remarked that authors have confounded the disposition of the abdominal walls in pregnancy at term with that of the non-pregnant condition.

In women at term the linea alba is generally from 3 to 4 inches broad at the level of the umbilicus; the lateral muscles contribute least to the amplification of the abdomen. Consequently the longitudinal incision into the linea alba is preferable.

If an oblique incision is made, M. Malgaigne advises that it should be made 2 inches outside, but at the level of, the umbilicus, terminating below in the middle line.

The incision in the linea alba should begin a little below the umbilicus, and end from 1½ to 2 inches above the pubis. Before it is made, the bladder and rectum should be emptied. The patient is held on a bed by assistants, one assistant fixing the womb with two hands applied to the sides of the abdomen. The surgeon then makes an incision which should be at least 5 to 7 inches long, and which should involve only the skin and subcutaneous cellular tissue; the aponeuroses are then to be divided layer by layer to the peritoneum; the peritoneum is at first to be carefully opened in such a way that a finger may be introduced, on the palmar aspect of which a blunt-pointed bistoury may be slid so as to enlarge the incision.

The womb is then incised layer by layer; the membranes are incised with the blunt-pointed bistoury like the peritoneum. The assistant whose duty it is to keep open the lips of the wound keeps those of the abdominal wound in relation with the lips of the uterine wound; the child is then extracted by the part which presents (Pl. LXXXVI., figs. 2 & 3), together with the placenta.

The transverse incision is made between the linea alba and the vertebral column at the level of the fundus uteri.

A second method has been proposed with the view of avoiding lesion of the peritoneum. Physick recommended a transverse incision above the pubis, stripping off the peritoneum, and incision of the uterus to the level of the stripped peritoneum. This process has been variously modified. Experience has not yet appraised the value of the second method ; and incision in the linea alba is generally preferred.

The operation should not be undertaken without having at hand an electrical apparatus to excite contraction of the uterus, should other measures fail to secure it. After the uterus has been emptied of its contents a clean probang, carrying a sponge as large as a walnut, or a disk of soft caoutchouc an inch and a half in diameter, should be passed through the cervix uteri and out at the vagina, so as to secure a free exit for lochial or other discharges. The probang should be from eight to twelve inches long, and the handle should be passed first through the cervix from above downwards, so that the larger end following may carry down any clots or other debris, and thus prove that a free channel diameters are not large enough for the passage of the fœtal head.

Nevertheless, in the present state of science, it cannot be considered as a regular and practicable operation ; the indications are vague and uncertain, the operation is dangerous, and premature delivery is, happily, applicable in cases which demand symphyseotomy. In forty operations Baudelocque found fourteen deaths ; thirteen children only were living, and most of the patients operated upon who recovered remained infirm.

Although these results are but little encouraging, we shall describe the operation.

Ordinary procedure (fig. 4).—An incision beginning a little above the pubis is practised in front of the symphysis, and is prolonged to the clitoris, inclining a little to one side so as to avoid one of the branches of the clitoris. This first incision comprises all the soft parts. The inter-pubic ligament is then carefully incised, so as to avoid wounding the bladder; as soon as the section is completed the bones immediately separate. Delivery then takes place naturally or by means of the forceps, according to the case.

MM. Imbert and Stoltz have proposed a subcutaneous method: the first with the bistoury passed under the skin near the clitoris, and cutting the symphysis from before backwards, the second with the chain saw acting on the side of the symphysis on the bone itself.

M. Gabbiati has also proposed and practised the double section of the pubis.

We cannot advise this operation, the indications for which, as we have already said, are not clearly laid down, and the results of which are most uncertain.

Fig. 1.—*Torticollis of the right the sterno-mastoid.*—*a*, cord-like pr shortening of the muscle.

Fig.* 2.—*Torticollis of the left side, of the muscle.*—*a, the sternal fasciculı made by the tenotome at the externa

Fig.* 3.—*Tenotomes, or tenotomy k Guerin, but in England discarded.

Fig.* 4.—*Operation for a torticollis the sternal and the clavicular fasci plate represents an assistant rotatin increase the tension and the promi muscle.—***a***, point at which the extre be felt beneath the skin, which, how trate; *c*, point at which the puncture

Fig.* 5.—*Same operation.—This figu operation as now performed. This knife is now never employed, nor is tenotome allowed to make its appe skin. The whole operation should be

Fig.* 6.—*Permanent contraction of club-hand.

TORTICOLLIS—SECTION OF TH

We recognise by the name of torti of the head and neck, more or less ma porary or permanent. Numerous *causes* are recognised. It may be the result of a traumatic or organic disease of the cervical vertebræ, or it may be due to the presence of a large tumour, or of bands or cicatrices, etc. It most commonly originates in contraction of the lateral muscles of the neck—the scaleni, platysma, and sterno-cleido-mastoid. This last being almost always the seat of origin of permanent torticollis, or, at any rate, the locality of the only form of the disease capable of cure by operation, will be the only muscle with which we shall concern ourselves.

For a long time attempts have been made to cure this disease by means of various forms of apparatus; but now section of the contracted muscle is regarded as the most efficacious procedure; bandages and other contrivances are only introduced as aids, although they are indispensable for securing a good result after treatment.

Anatomy.—Bouvier, Malgaigne, and other surgeons have proposed various positions for the point of section of the sterno-mastoid, but the division is usually made in the lower third, the tendinous portion being preferred.

The muscle in its lower portion consists of two distinct fasciculi: the inner one very firm—half an inch wide—fibrous the length of an inch or more. It is inserted into the upper anterior surface of the manubrium sterni, in front of the sterno-clavicular joint; its more internal fibres often touch those of the other side. The second and outer fasciculus, larger, broader, and thinner than the first, with very short tendinous fibres at its lower extremity, is connected with the inner third of the clavicle. Though sometimes the two tendons are in contact and almost united, yet in other cases, especially in thin subjects, they are quite distinct, as can be made out by sight and touch; a depression marks the cellular inter-space between them.

Jules Guerin, who has clearly shown the functional independence of the two heads of the muscle under consideration, showed that the sternal origin of the muscle is the part usually affected; contraction of the clavicular portion, which is much rarer, producing inclination of the head to one shoulder,

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OPERATIONS

The necessary apparatus consists c
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the section.

Dupuytren was the first to subcuta
mastoid; he was followed by Strome

put the affected muscle more than ever on the stretch. It then forms so marked a projection that it can be held by the fingers of the left hand. This circumstance is of real help in making the section. The surgeon, standing in front of the patient, takes up a vertical fold of the skin, parallel to the axis of the muscle, its base corresponding with the outer edge of the muscle (when the skin is naturally loose): the surgeon then pierces the skin with his knife, at a point answering to the outer edge of the muscle, and ¾ of an inch above the clavicle or sternum, using for this purpose a sharp-pointed convex tenotome, whose blade is ⅛ of an inch broad. The instrument is passed from without inwards, between the skin and muscle, the back turned downwards, the edge upwards, until it reaches and passes the inner edge of the sternal origin of the muscle, carefully avoiding any perforation of the skin; then the surgeon gives a quarter rotation to the knife, so that the edge touches the anterior surface of the tendon. The skin is now held no longer, and the knife is drawn slowly backwards and forwards across the tendon, until a peculiar sound—a kind of cracking—shows that the tissue is divided, when the knife is withdrawn through the passage by which it was introduced. If the two portions of the muscle are both contracted, the clavicular origin is to be attacked at the same time as the sternal, and without making fresh wounds; the muscle is put on the stretch by binding the head over to the opposite side, and the tenotome is passed again through the same wound, but from within outwards, following the same rules as before; but the knife must not go far beyond the outer edge of the muscle lest the external jugular be wounded.

Surgeons are not afraid as to the direction of the incision. Cutting from before backwards is safer as regards the vein, but, on the other hand, the fibres are more likely to be left undivided in this procedure. Malgaigne recommends cutting the clavicular portion from before backwards, on account of the jugular vein, and, because of its greater ease, he would divide the sternal origin from behind forwards. But M. Guerin is diametrically opposed to him on this last point.

The muscle can be cut just as well, in either way; but if the

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When transfixion is finished, the
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The drawback to this method
wounds; it is not often employed,
is usually preferred.

PERMANENT CONTRACTION OF HAND, SECTION OF PALMAR A FLEXOR TENDONS.

Permanent contraction of the
or accidental. It arises from bu
disease peculiar to the fascia itse
may be simple, and limited to th
accompanied by general deformity

to these cases. The fibrous band was put on the stretch by forcible extension of the finger, a straight-bladed bistoury was passed under the skin and made to divide the contraction without cutting the integument. If then extension could not be properly effected, the incision was repeated in another place. The fingers had to be kept straight by suitable apparatus.

Dupuytren operated by open incision. The hand being supinated, and the fingers extended as far as possible, he cut down upon the contracted band at its most prominent part, somewhere near the metacarpo-plalangeal joints. The skin being cut through transversely to the extent of an inch, the fibrous band was laid open and cut completely through. A second incision was made higher up or lower down; if the hand could not be easily extended, the fingers were bandaged to a digitate splint, applied to the dorsal surface; and the wounds, dressed with lint, slowly cicatrised; but the deformity often reappeared after a shorter or longer interval.

Goyrand cuts through the skin longitudinally at the most prominent part of the band, and dissects aside the integuments on each side, thus laying the contraction bare throughout, which is then divided at one or two points and removed; the lips of the wound are then brought together.

When contraction of the fingers is due to the flexor tendons, division has been proposed at the level of the first phalanx, in the palm, or near the wrist even. This matter has been the subject of most lively controversy, and is not yet settled.

Most surgeons have declined the operation because tendons divided in their synovial sheaths seldom reunite: the fingers can be straightened, but afterwards can rarely be flexed properly. Hence tenotomy of the fingers is only to be performed in very rare cases. Contraction of the flexors and other forearm muscles, is the most common cause of clubbed hand. Subcutaneous division of the tendons is evidently indicated, and rarely presents any great difficulty.

Fig. 1.—*Tenotomes*—*a*, tenot
b, tenotome cutting on its conve
for puncturing the skin.

Fig. 2.—*Division of tendo-Ac*
a', the two ends of the tendon s
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eurosis which separates the supe
c, the crural aponeurosis which f
sheath of the tendo-Achillis ; *d*, s
tion be seen.

Fig. 3.—*Talipes equinus.*—The
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raised by the contraction of the
puncture of the skin, where the te

Fig. 4.—*Operation of dividing t*
of the surgeon and his assistant.—
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Fig. 5.—*Talipes calcaneus.*—The
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do not touch at all.—*a*, *a*, point in t
ought to be introduced to cut t
digitorum.

Fig. 6.—*Talipes valgus.*—The fo
the outer edge is raised from the
outwards.

Fig. 7.—*Talipes varus.*—The sole
concave

tendons, or aponeuroses. Subcutaneous tenotomy is successfully employed in the cure of these deviations.

There are many varieties of clubfoot, but they are always in some way related to the normal movements of the sound foot, of which they seem to be merely exaggerations, as is well seen in cases where the deformity is simple and at an early stage; while, on the other hand, in extreme cases, the deformity is so great that the foot may take any strange forms.

Extension of the foot causes *talipes equinus*, in which the heel is strongly raised, and the foot, placed in a line with the leg, only rests on the ground by the toes or ends of the metatarsus. Talipes equinus is caused by contraction of the tendo-Achillis, and of the common flexor of the toes.

Flexion of the foot causes *talipes calcaneus*, which is just the reverse of the preceding. The heel alone rests on the ground, the plantar surface of the foot being directed forwards; the toes which cannot touch the ground are more or less drawn upwards, and towards the crest of the tibia. This variety, the rarest of all, is due to contraction of the anterior tibial and peroneal muscles, and of the common extensor of the toes.

Adduction of the foot is found in *talipes varus*, the commonest form of all. The foot touches the ground on its outer edge, the inner is turned up, the sole looks inwards, the toes are almost always flexed, and the heel raised from the ground. This kind, especially when of long standing, is almost always associated with talipes equinus. The cause of talipes varus is contraction of the tibial muscles, the tendo-Achillis and plantar fascia.

Abduction is represented by *talipes valgus*, which is the reverse of the last kind. The foot rests on its inner edge, from which the concavity is gone, the outer edge and sole of the foot no longer rest on the ground, and the latter looks outwards. This kind is usually combined with talipes calcaneus, and is the result of contraction of the peronei; the deformity known as *flatfoot* is a mild form of valgus.

If the malformation is originally due to muscular contraction, there soon arise other causes for its perpetuation, in gradual involvement of the fibrous tissues, the articular ligaments, the

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by the plantar fascia. In the second
the tibialis posticus, long flexor of th

Section of the tendons of the fir
follows. Only one opening is made
possible, the size not exceeding that
is to be no larger than is required for

The opening must be at such a d
that its course can be oblique, thus

is opposite the tendon, the knife is to be turned through a quarter rotation, so that the edge presses against the tendon, and the back is in contact with the deep surface of the skin. Convex tenotomes are preferable to those which are straight or concave, or two may be used, one pointed and straight, the other blunt and convex. While the knife is being introduced, the tendon is to be relaxed that the blade may glide between it and the skin; but it must be stretched during section, an assistant keeping the limb in the requisite position.

When selecting the method of cutting the tendon from its deeper surface, the tendon should be relaxed, and if possible raised by the thumb and index finger of the left hand, when the knife can be easily inserted beneath it. The tendon is then put firmly on the stretch whilst the section is being made.

The surgeon knows when the section is complete by a slight shock accompanied with a peculiar sound, by the disappearance of the prominent cord, and sometimes by the perceptible interval between the cut ends.

These general principles being given, we proceed to examine the division of special tendons separately.

Section of tendo-Achillis.—This operation is undertaken for the cure of talipes equinus, but it is often required for equino-varus, and even for simple varus in young children. It has been employed in a variety of cases, as, for instance, in the retraction of the tendo-Achillis, after Chopart's amputation, and in some cases of irreducible fractures of the leg it has proved most efficacious.

Surgical anatomy.—The tendo-Achillis consists of the combined insertions of the muscles of the calf. Wide above, the tendon converges its fibres in descending, so as to form a vertical cord, which makes a well marked prominence, capable of being embraced by the fingers for a length of 2 inches or more.

The height above the os calcis at which the fleshy fibres end varies, but is seldom less than two inches. The tendon at its lower end widens for insertion into the tuberosity of the calcaneum, from which it is separated by a bursa. As it is necessary to avoid the bursa below, and the muscular fibres

covered behind by the skin alone
with the deep muscles, and especi
nerves, from which it is only sepa
heel, the tendon is at some distan
thick layer of fat and cellular tissu
below the point indicated above
more risk of wounding the vessel
lessened by introducing the knif
tendon.

The tendo-Achillis is surrounde
fibrous sheath, in which the two
and which plays an important par
divided tendon. Fig. 2 shows the
the separation of the cut ends.

OPERATIO

The patient lies on his face, a
about its centre, and the foot
sole. In the first stage, the foot
tendon, while the knife slips unde
stage, the tendon is made very tense
surgeon, standing on the inner side
skin with a lancet, or the sharp tenc
the tendon at the point selected a
instrument is introduced on the fl
face of the skin and the prominer
hand. beneath

A pad of lint and a piece of plaster is applied over the wound, and the foot retained in its original position by a flexible metal splint. The scarpa's shoe may be applied two or three days later.

Division of the tibialis anticus.—This is practised in the treatment of talipes calcaneus, and in talipes varus, though Bonnet considers that it may be dispensed with in the latter affection. It is performed at the point where the tendon makes its prominence under the skin most evident; that is, about the level of the tibio-tarsal joint. This tendon should certainly not be cut from the surface downwards, for fear of injuring the joint and the dorsal artery of the foot. The knife should be entered on its outer side and slipped beneath the tendon cutting towards the surface.

Division of the extensor pollicis, extensor communis digitorum, and peroneus tertius.—This operation may be called for in talipes calcaneus, valgus or varus. The prominence of these tendons under the skin renders their division easy. They can be reached by one or more incisions made in front of the malleoli, above the level of the tibio-tarsal articulation (fig. 5, *a*, *a*). Bonnet prefers to operate at the level of the metatarso-phalangeal articulations; there is less risk in that proceeding of wounding the nerves and the vessels of the dorsum of the foot. The section of all the tendons is effected at the same operation.

Section of the plantar fascia.—Contraction of this structure is very common in talipes. It is usually about the level of the joints, between the first and second row of tarsal bones, that the prominences of the fibrous bands are most marked; they may be cut from the surface downwards. The numerous processes of tissue to the sides and into the depth of the sole render complete division of the plantar fascia very difficult; in fact, the result seldom appears at once. The methods of operating on the palmar fascia are equally applicable to these cases.

Section of the muscles of the thenar and hypothenar eminences is seldom effectually performed, and no clear rules can be laid down.

The *peronei* and *tibialis posticus* form another class of

puncture as before described.
tome under the tendon and
surface. Cutting from the
mended for the preceding m
joints and wounding the vess

Section of the peronei.—Thi

(1) Behind the fibula, ¾ o
malleolus, it is possible to
from the surface downwards;
low down the tendon the divisi

(2) These tendons may alsc
outer malleolus, near the poi
There is, however, greater risk
which account the first operatio

(3) Lastly, the operation m
malleolus, but the manœuvre is
the groove in which the tendons
is employed in cases of valgus, a
the relief of flat foot (Bonnet).

Section of tibialis posticus.—I
of varus in adults this tendon n
tion varying according to the de
equinus the tendon is divided b
also be cut below the ankle as
prominence of the scaphoid; le
skin ⅓ of an inch above and a lit
until the knife reaches

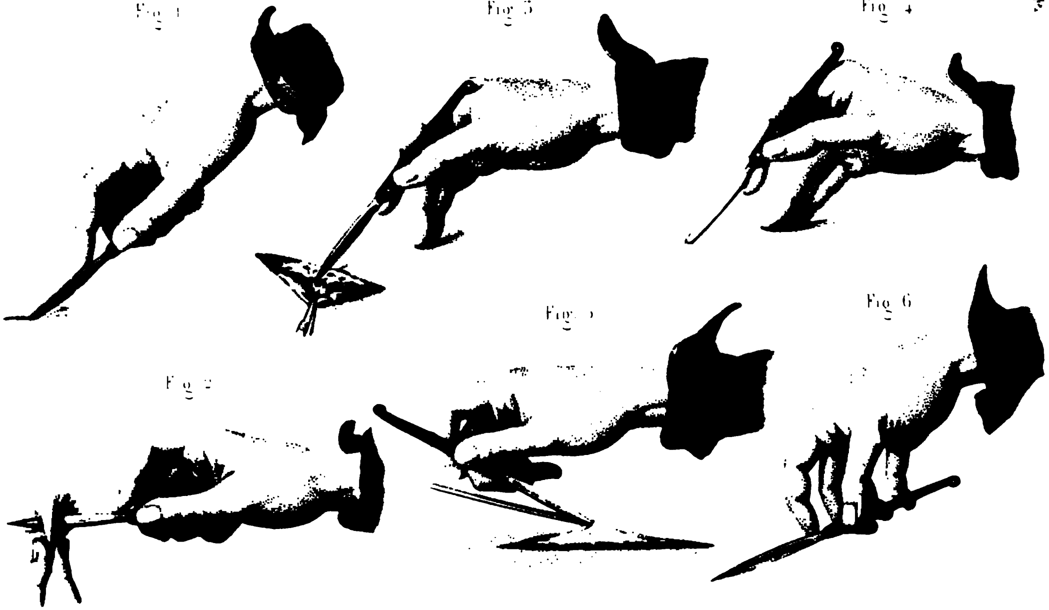
must be divided behind the malleolus; but the result is less certain; if the instrument is carried too deep there is much risk of wounding the artery. M. Bonnet thinks this has often happened, but rarely with any great injury.

Section of the tendons of the flexor longus pollicis and flexor communis digitorum.—The deep position of these tendons prevents their being divided with certainty near the malleoli or in the sole; the operation must, therefore, be performed near the first phalanges of the toes. The methods applicable to the muscles of the first category are used here: puncture of the skin and division of the tendon must be performed in each toe, the chief inconvenience being the length of the operation. The same remarks are applicable to the flexor brevis digitorum. It usually happens that the tendons of the long and short flexors are cut at the same time, as is shown by the simultaneous retraction of the two muscles.

THE END.

Hazell, Watson, and Viney, Printers, London and Aylesbury.

Pl. 1



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PI. 2.

Fig. 9

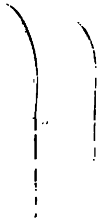
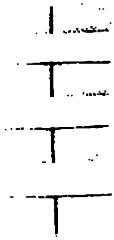


Fig. 1



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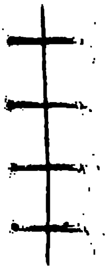

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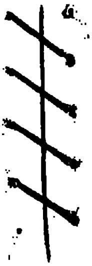

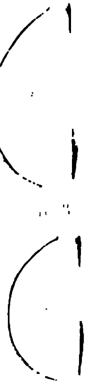

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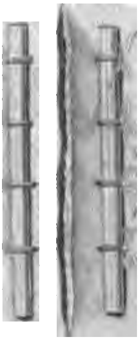

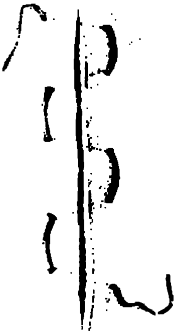

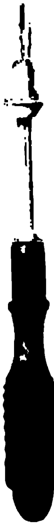

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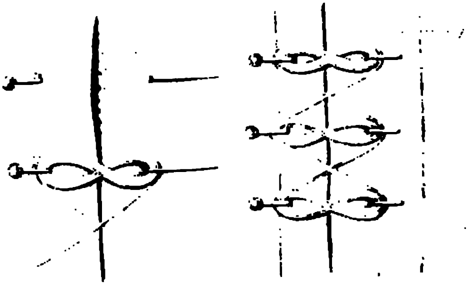

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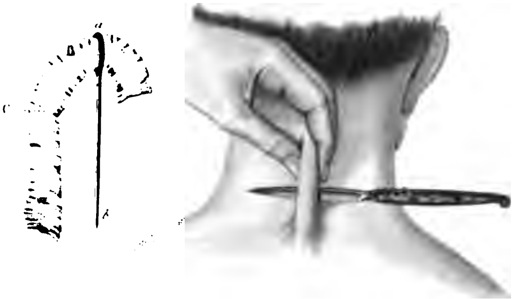

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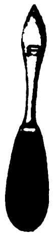

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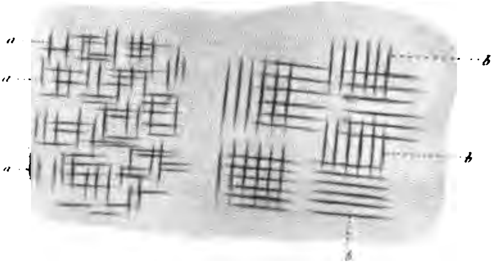

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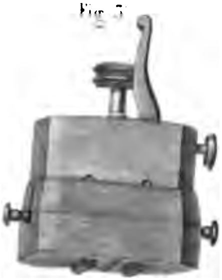

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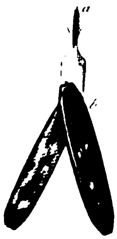

Fig 4

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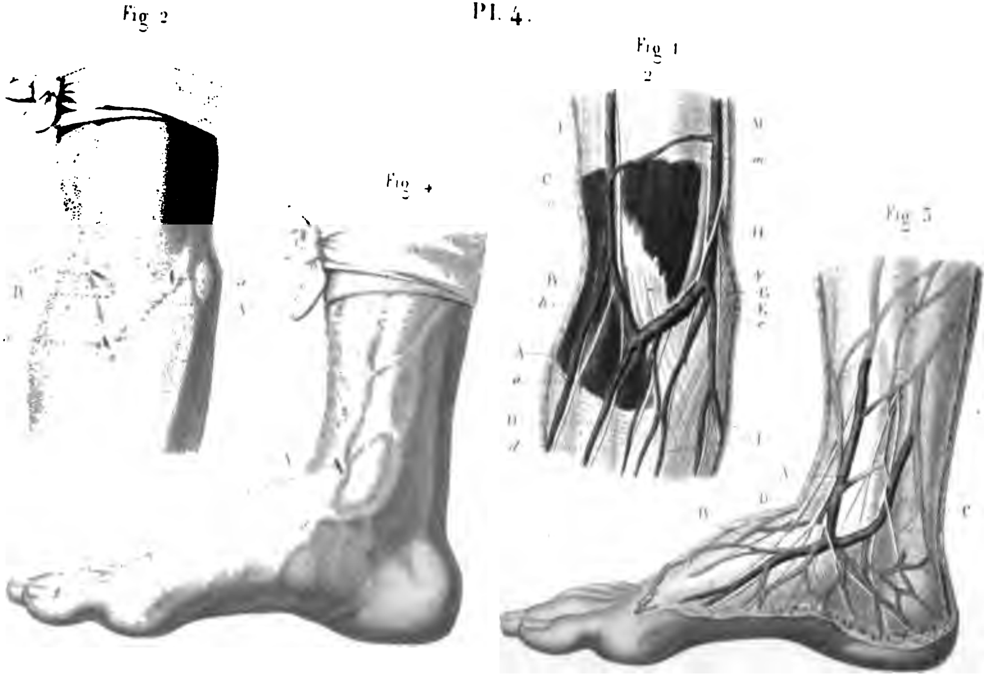

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Pl. 5.

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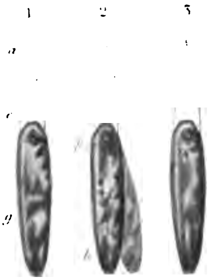

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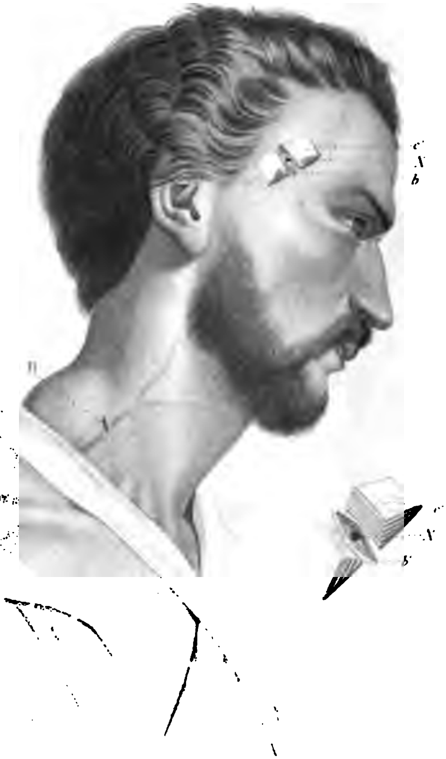

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Pl. 6.

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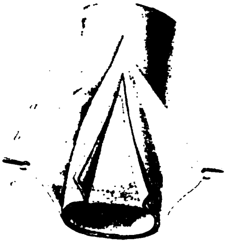

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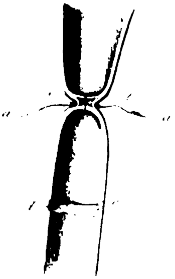

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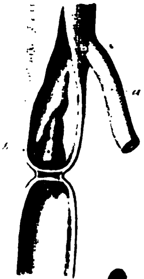

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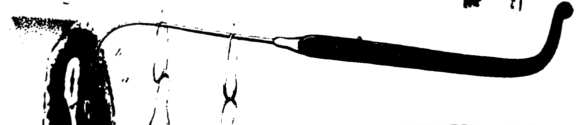

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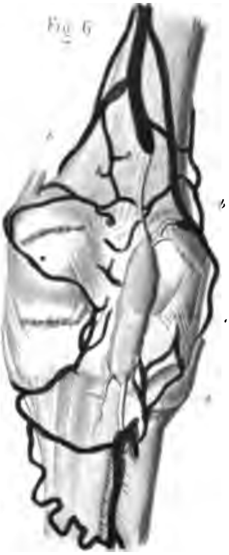

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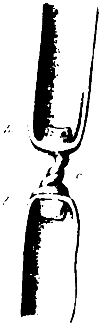

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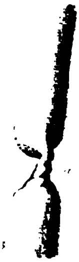

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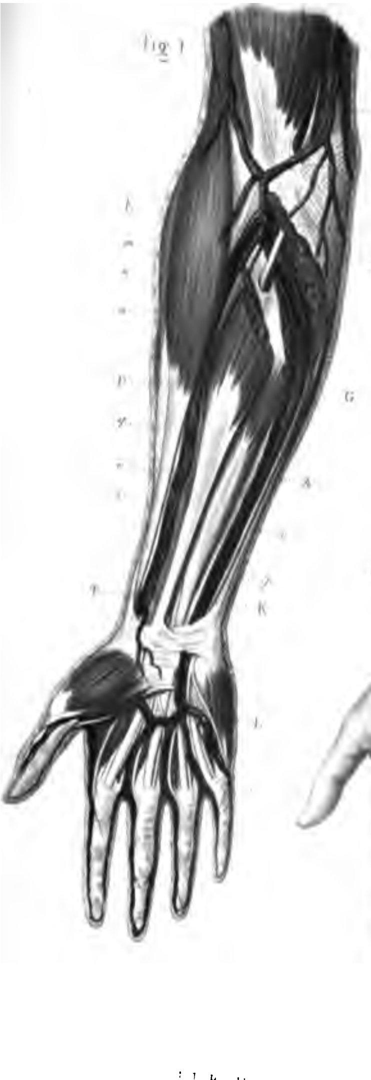

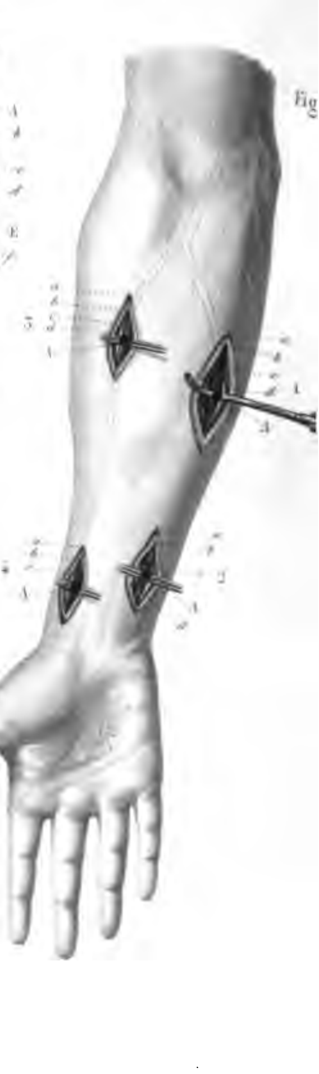

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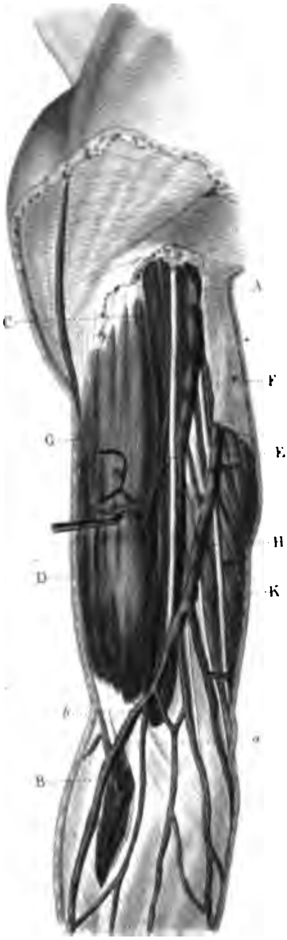

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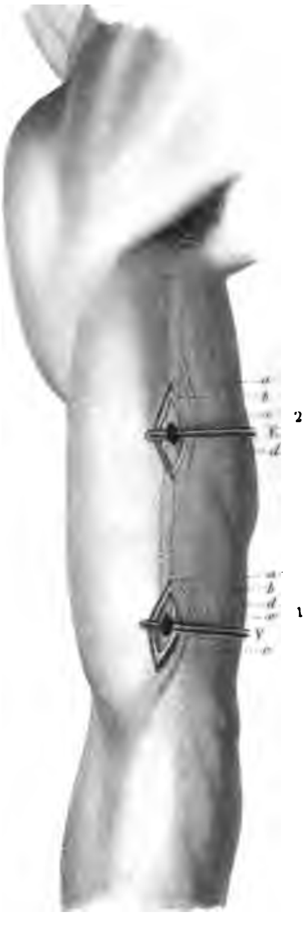

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Pl. 9.

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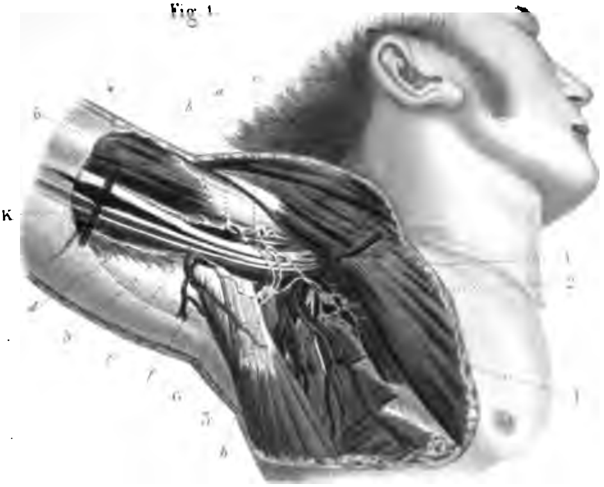

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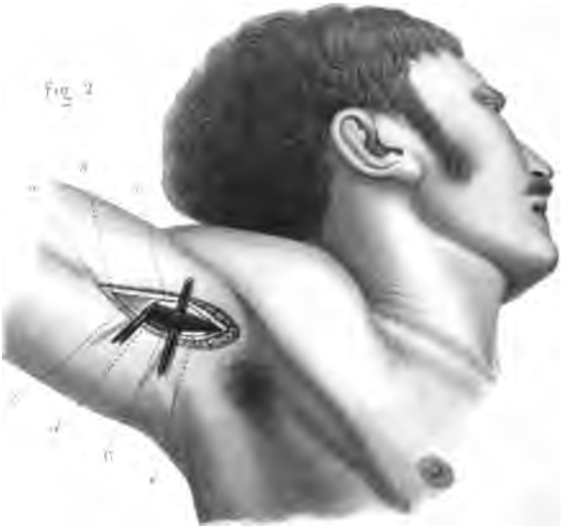

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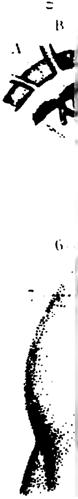

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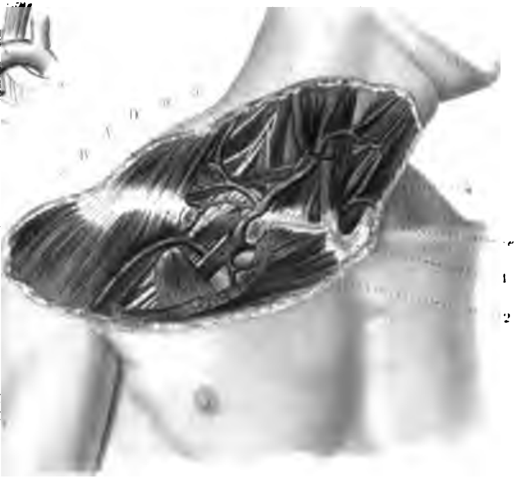

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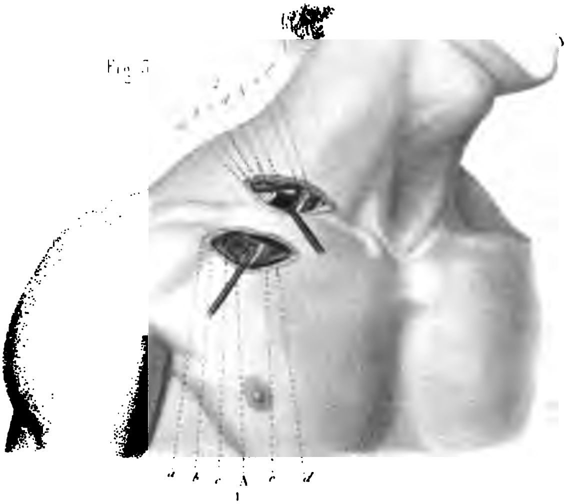

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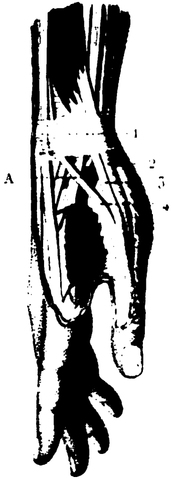

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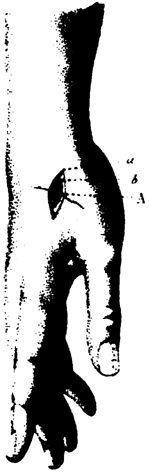

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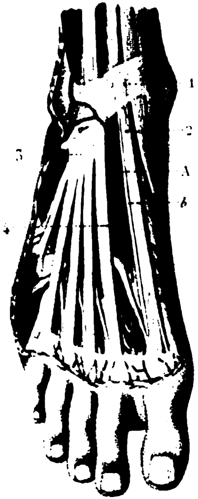

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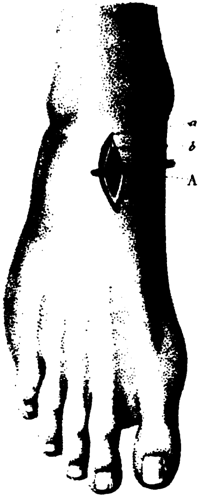

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Pl. 13.

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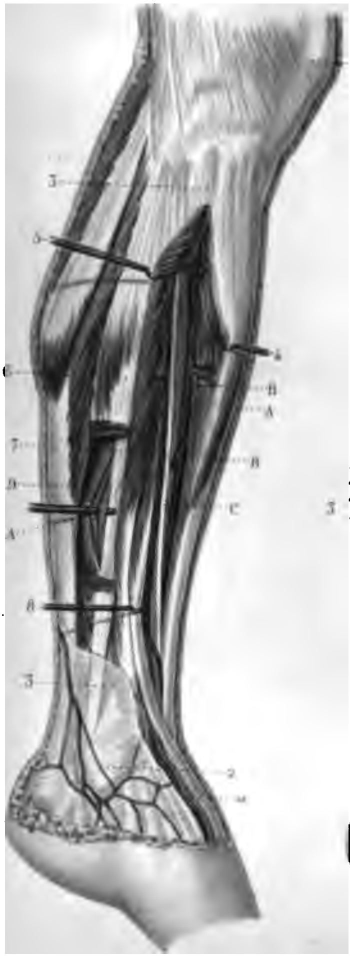

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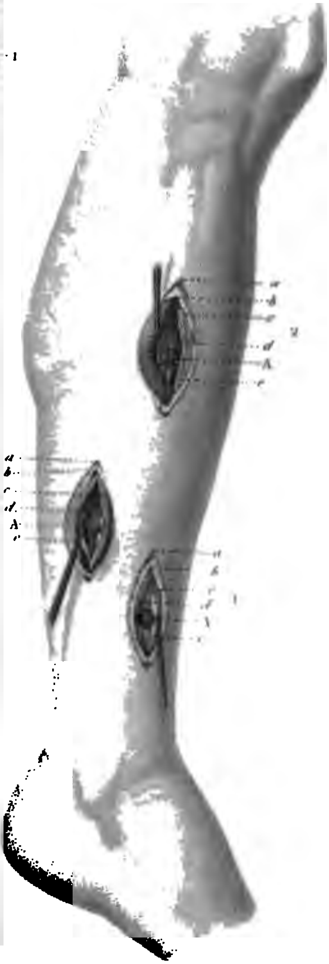

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Pl. 13.

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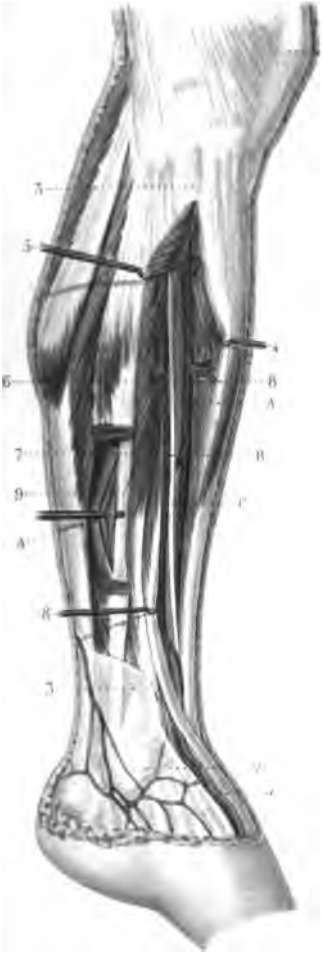

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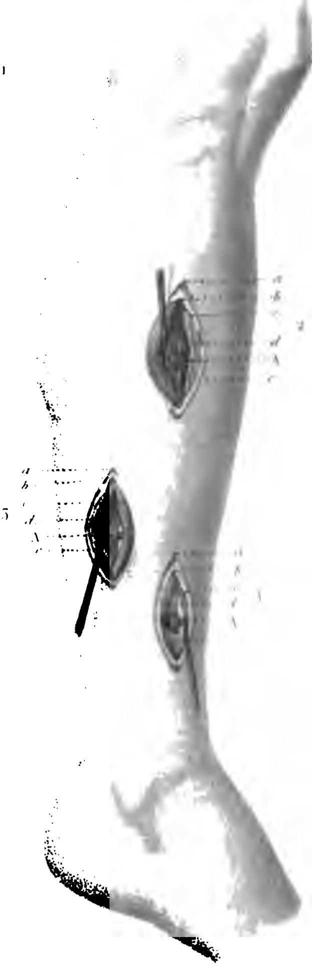

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Pl. 14.

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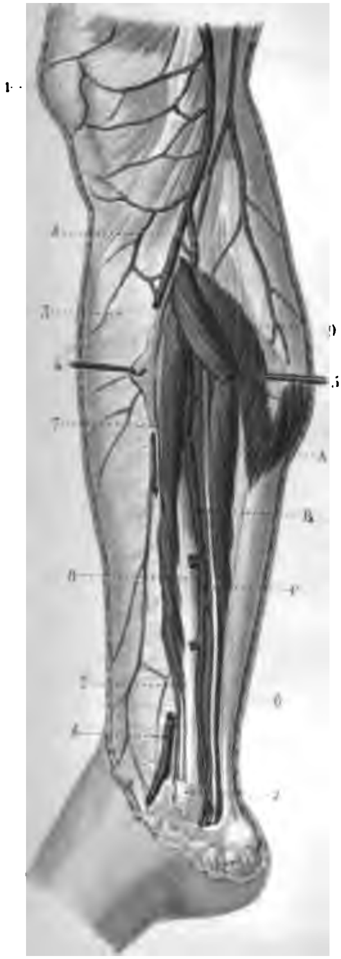

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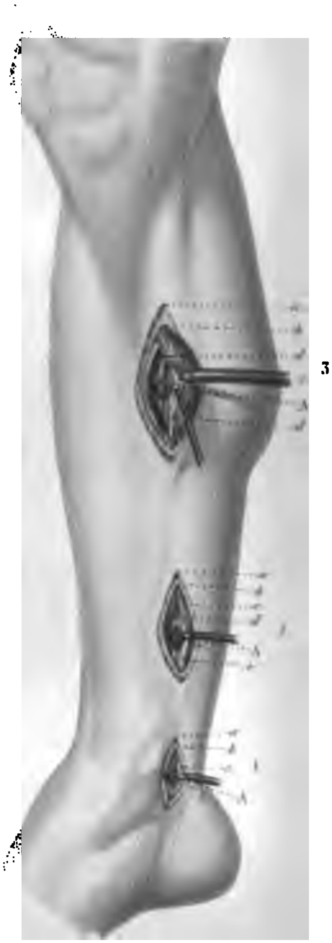

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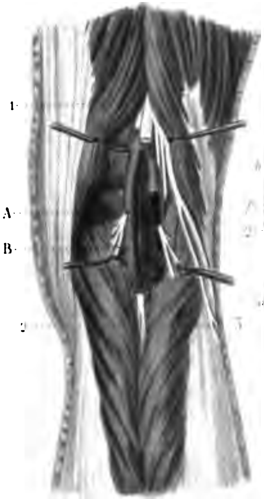
Fig 2



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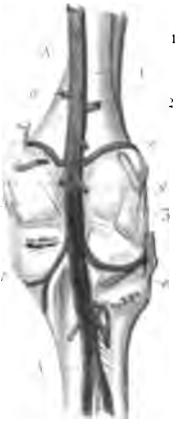

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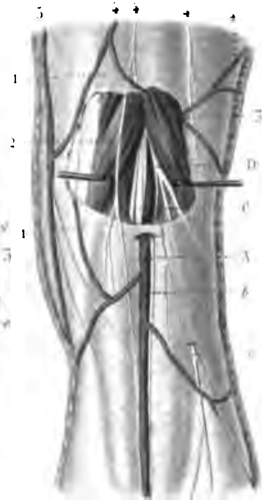

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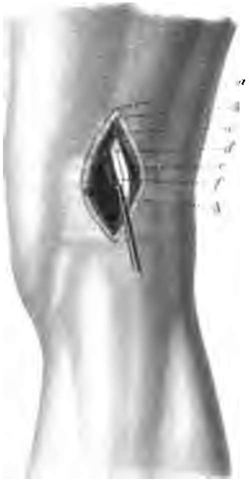

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Pl. 16.

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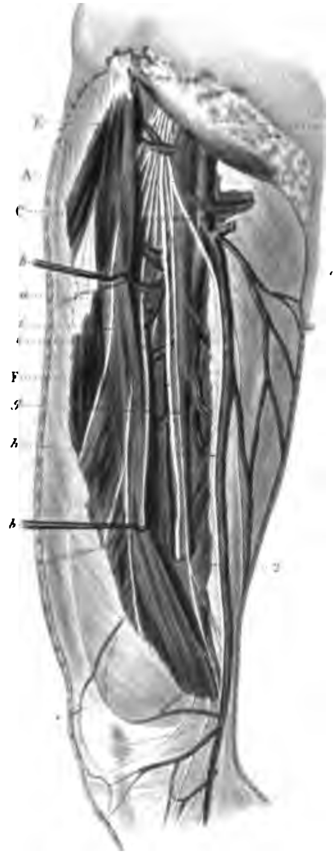

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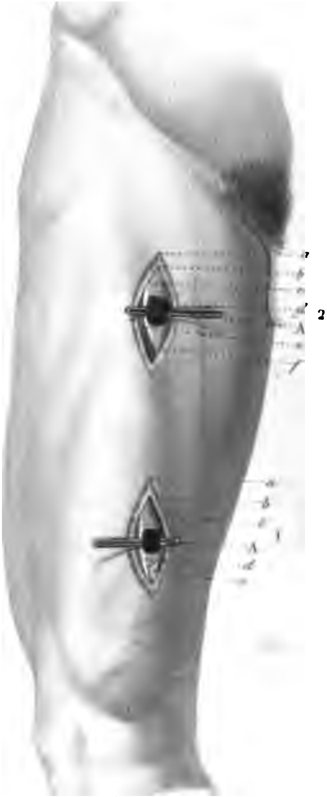

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PL. 17.

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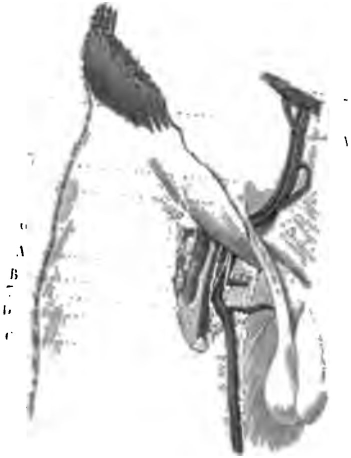

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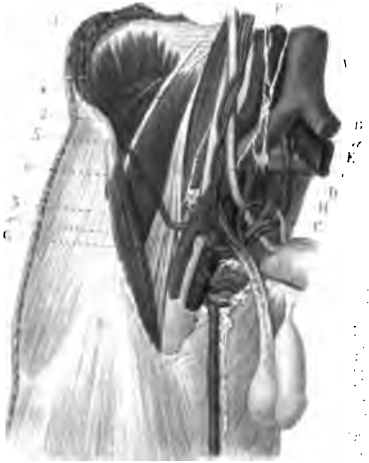

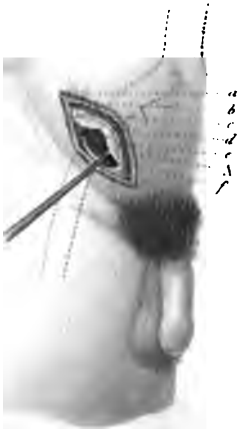

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Pl. 19.

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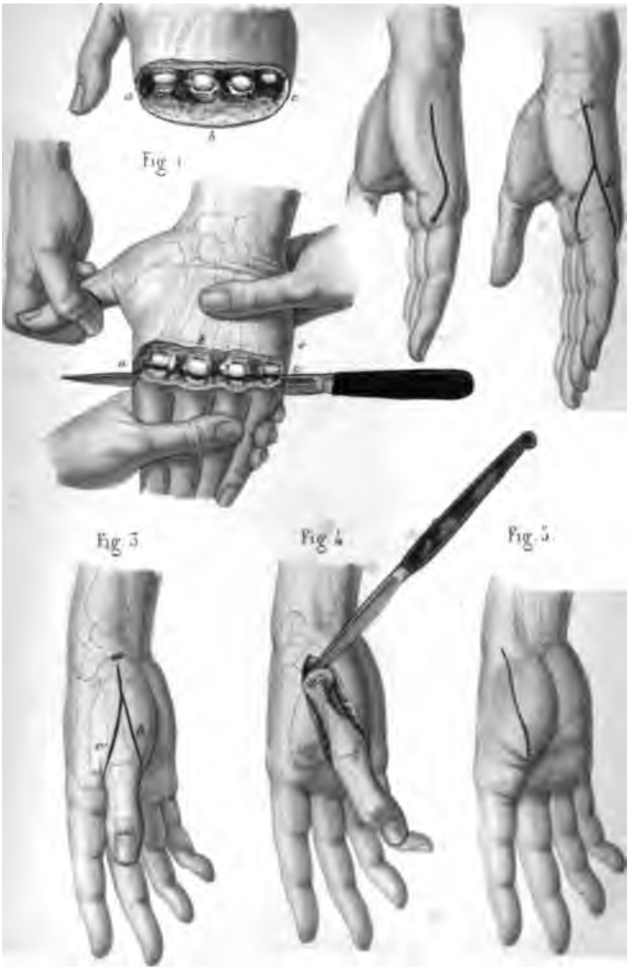

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Pl. 19.

Fig. 2

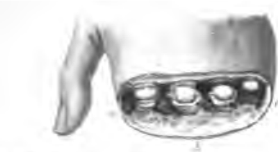
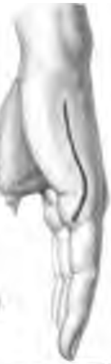


Fig. 7



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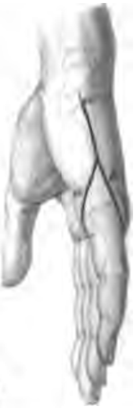
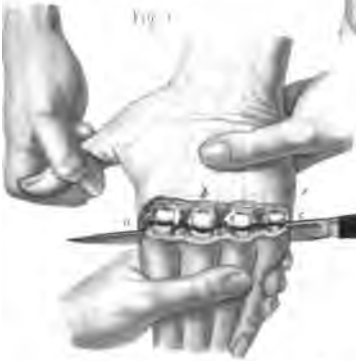


Fig. 1



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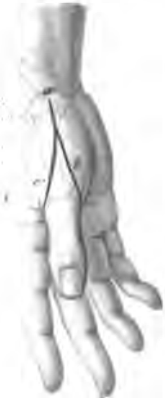

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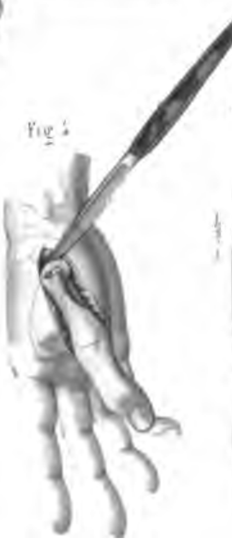

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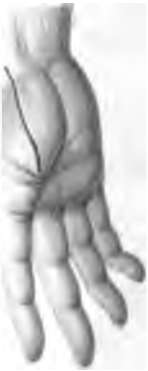

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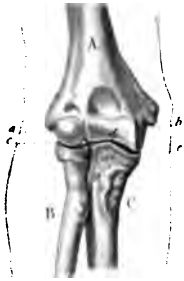
Pl. 21.

Fig. 3.



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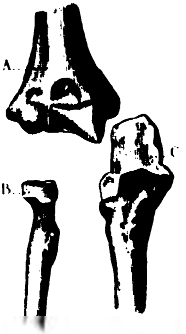

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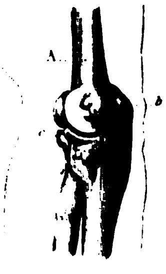

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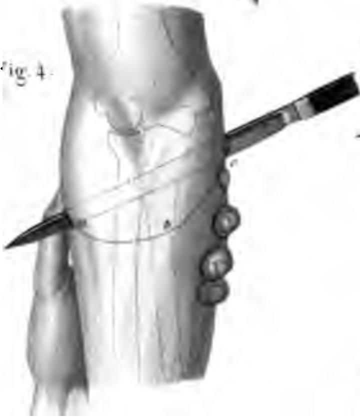

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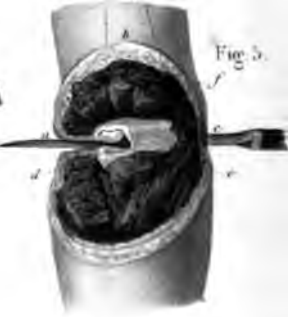

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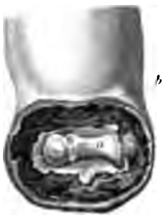

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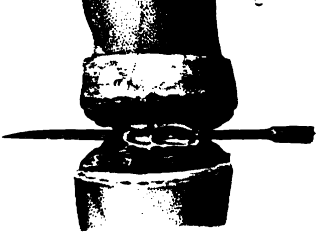

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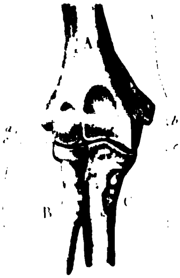
Pl. 21.

Fig. 3.



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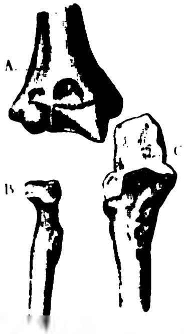

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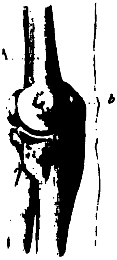

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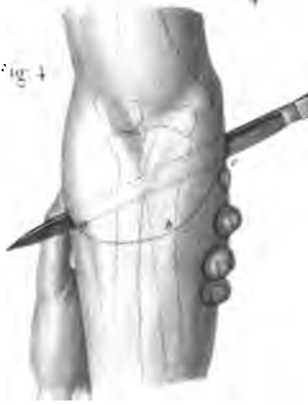

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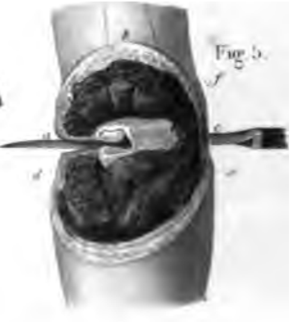

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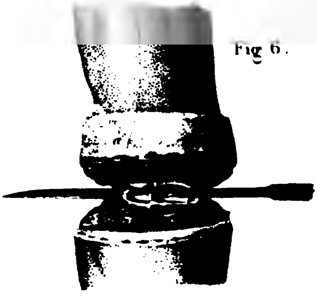

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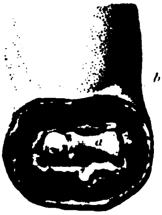

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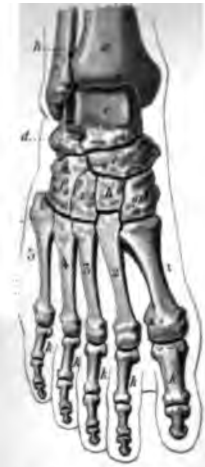
Pl. 23.

Fig. 1.



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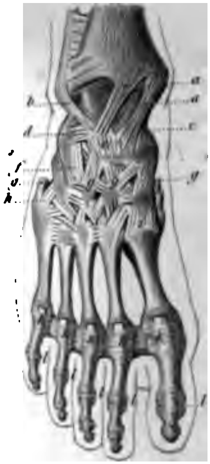

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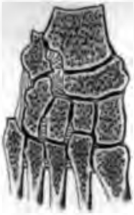

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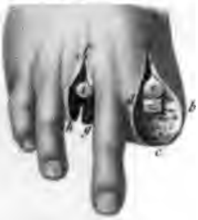

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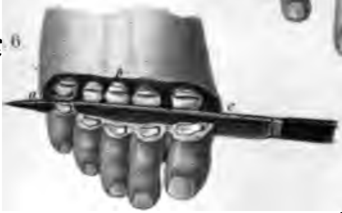

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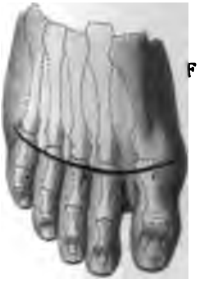

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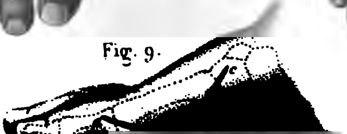

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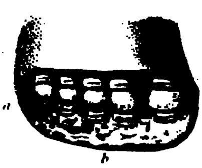

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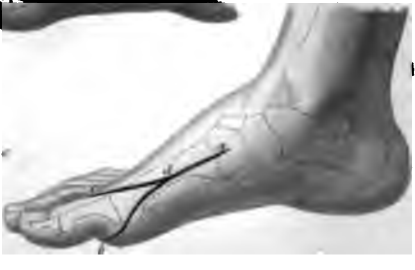

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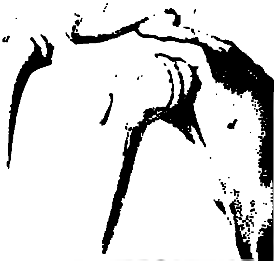
Pl. 22.

Fig. 1



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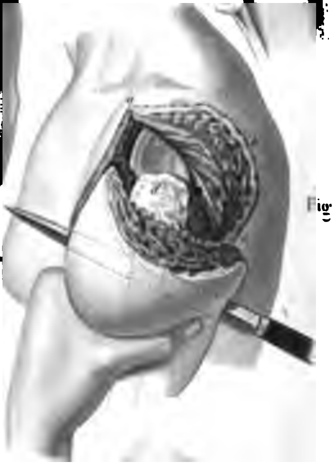
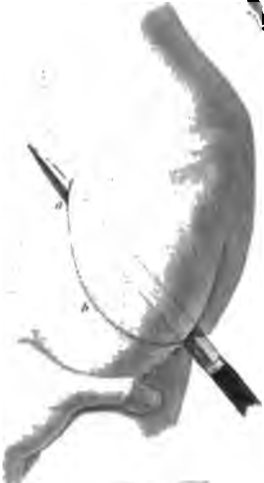


Fig. 4

Fig. 3



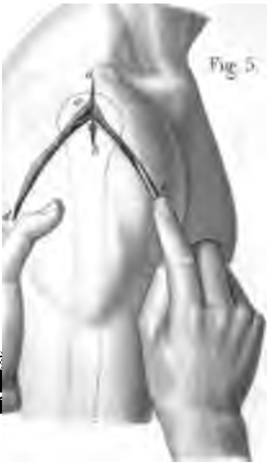
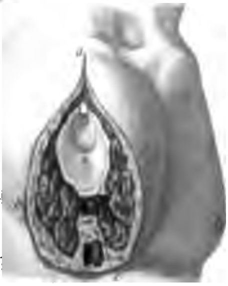


Fig. 5

Fig. 6



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Pl. 22.

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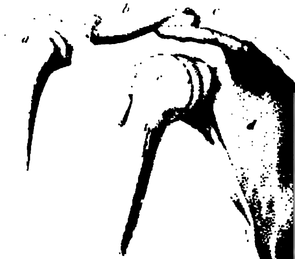

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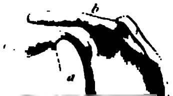

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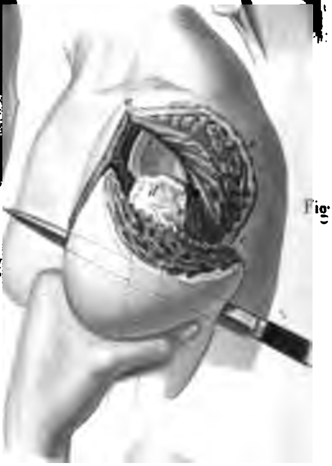

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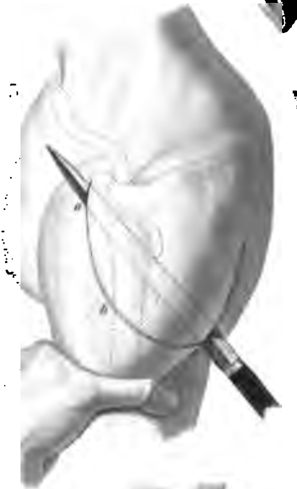

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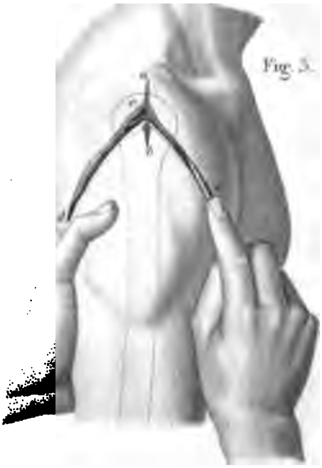

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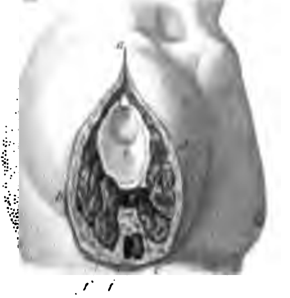

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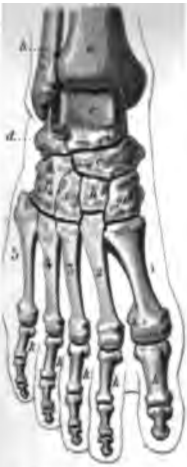
Pl. 23.

Fig. 1.



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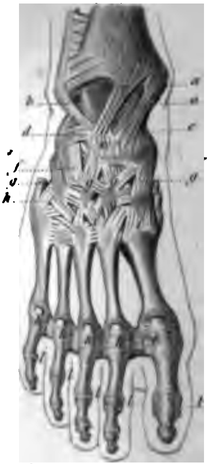

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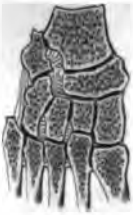

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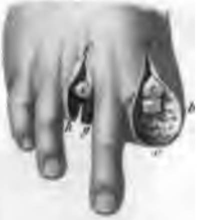

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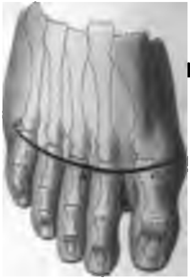

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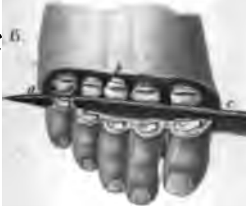

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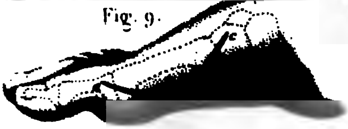

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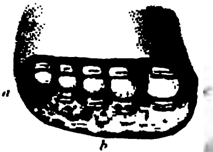

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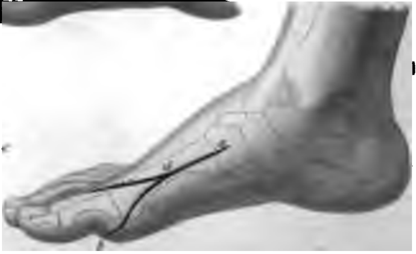

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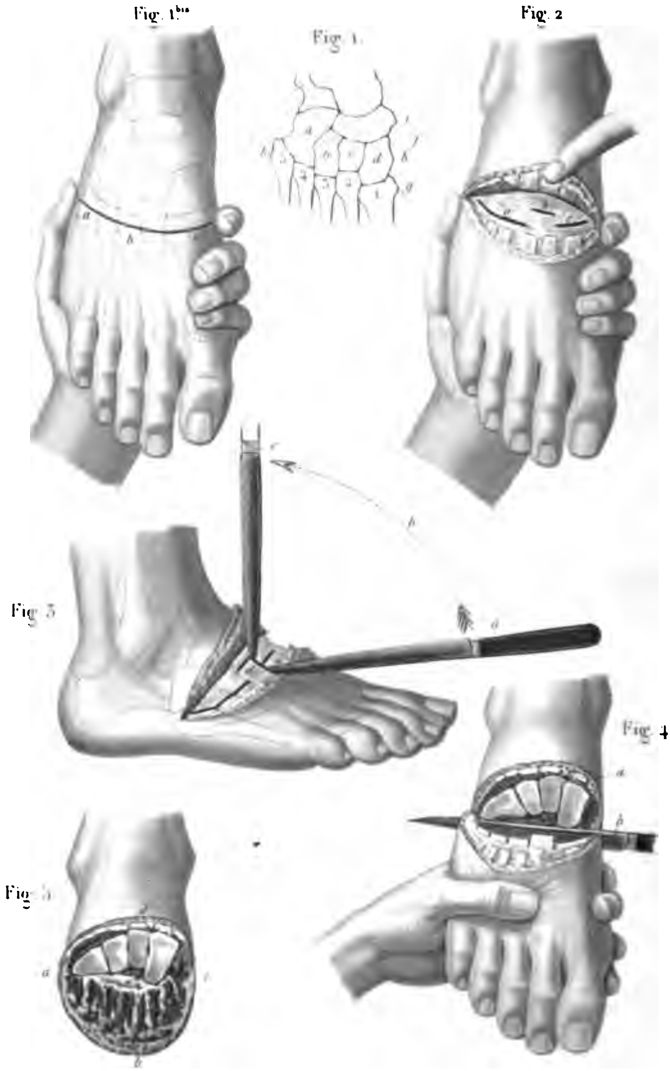
Pl. 24.



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Pl. 25.

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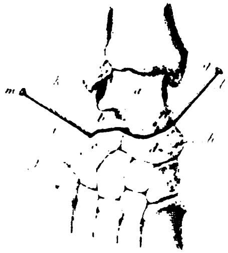

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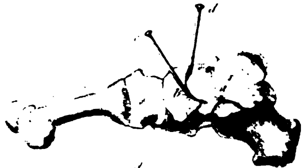

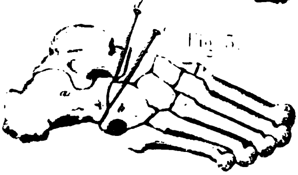

Fig. 3.

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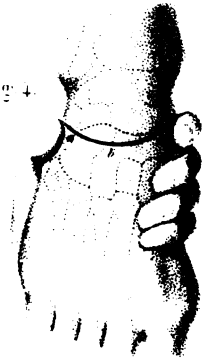

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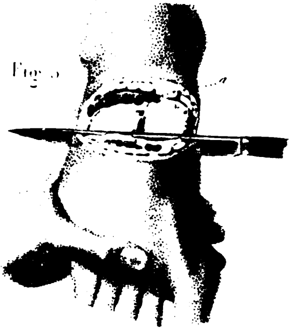

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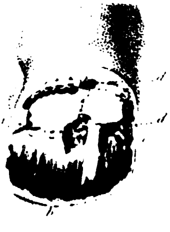

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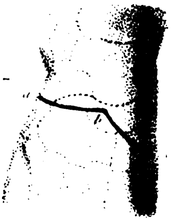

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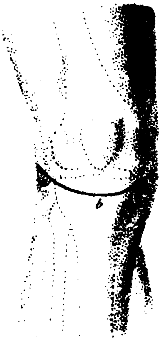
Fig. 3.



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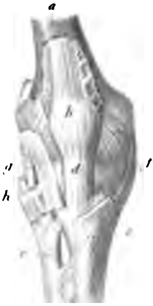

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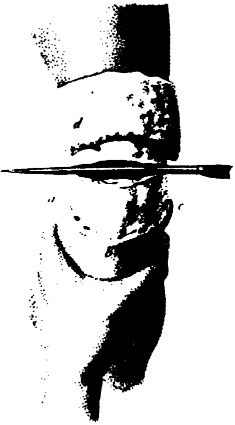

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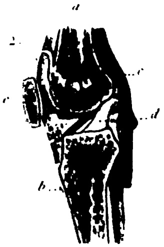

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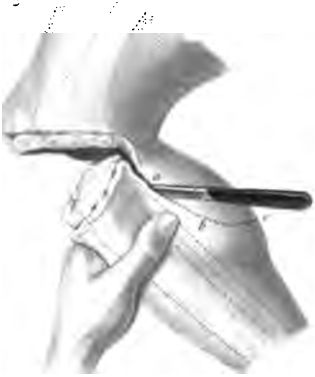

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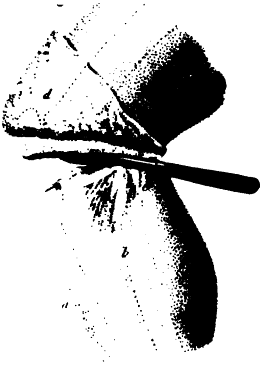

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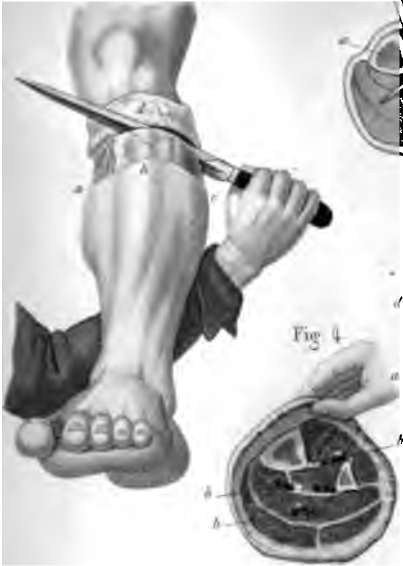
Pl. 30.

Fig. 1.

Fig. 4.



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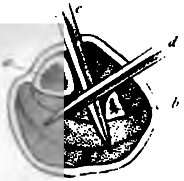

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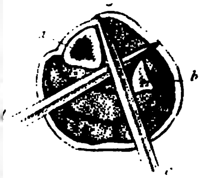

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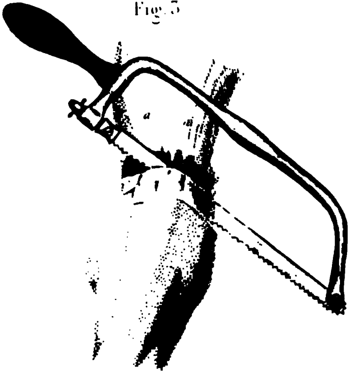

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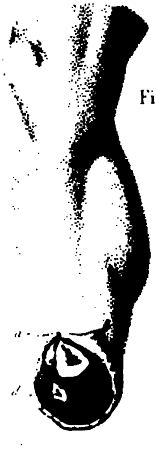

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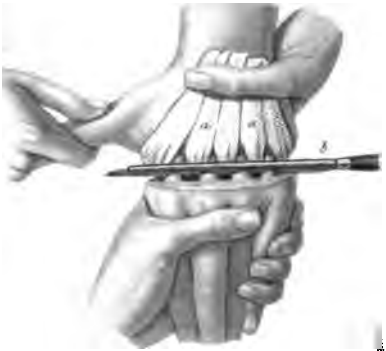
Fig 3.



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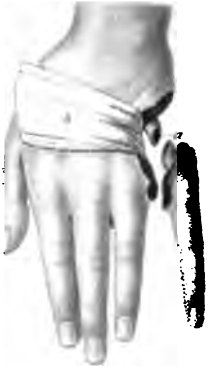
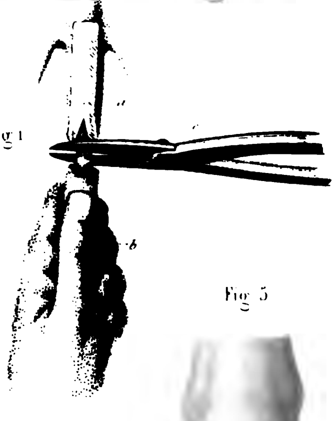


Fig 1



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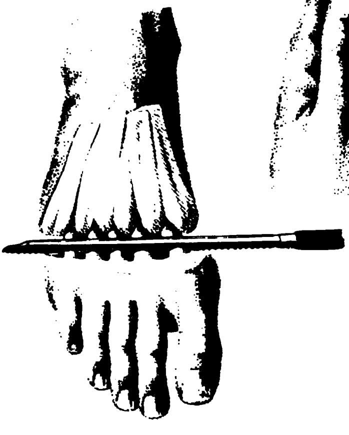
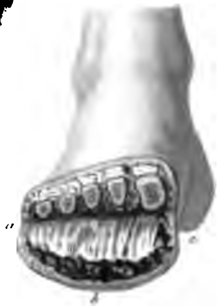


Fig 5



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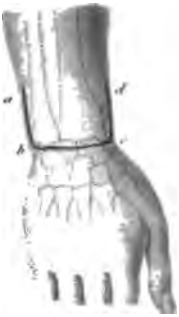
Pl. 32.

Fig. 1.



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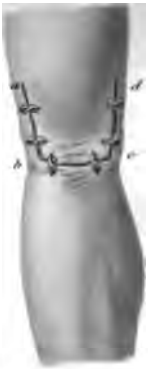

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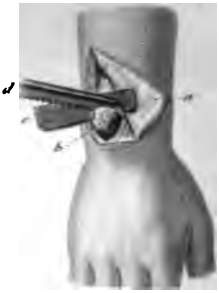

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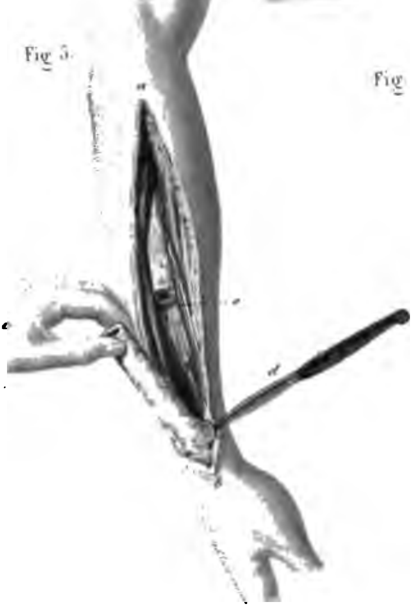

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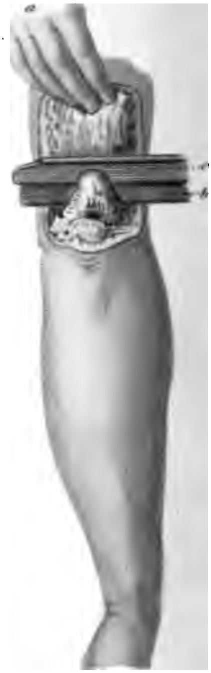

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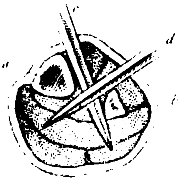
Fig. 2.



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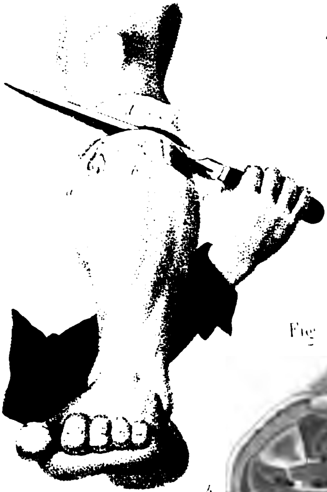

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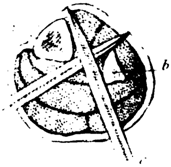

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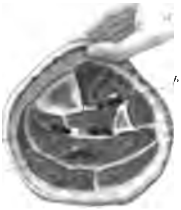

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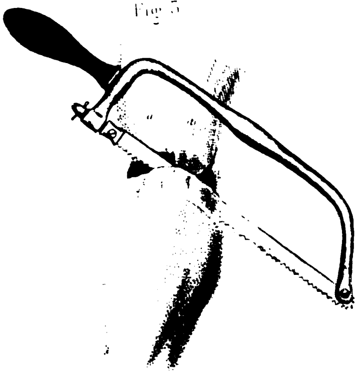

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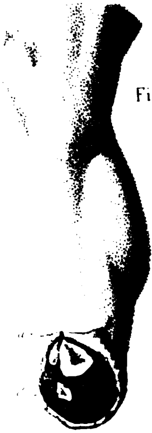

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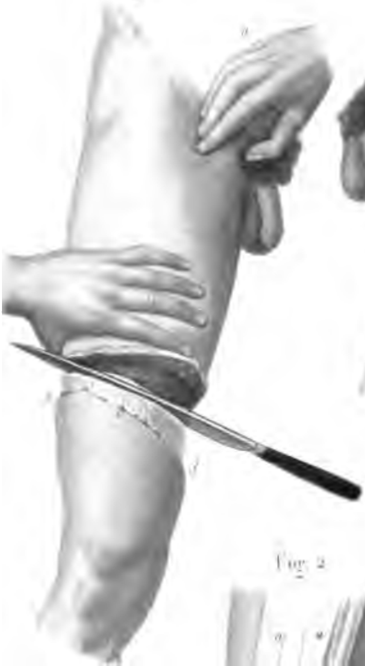
Fig. 1.



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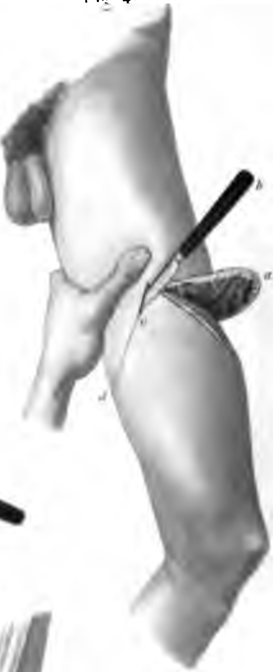

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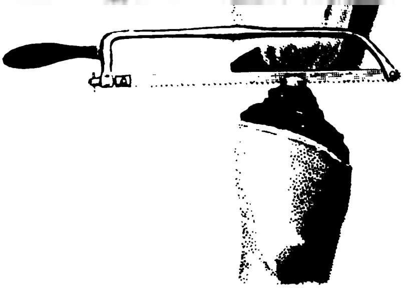

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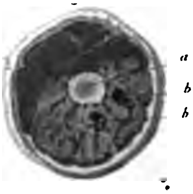

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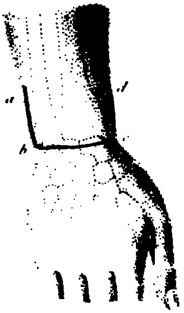

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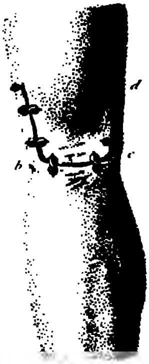

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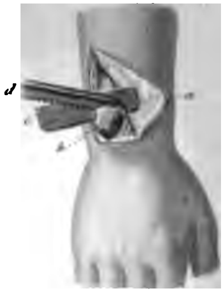

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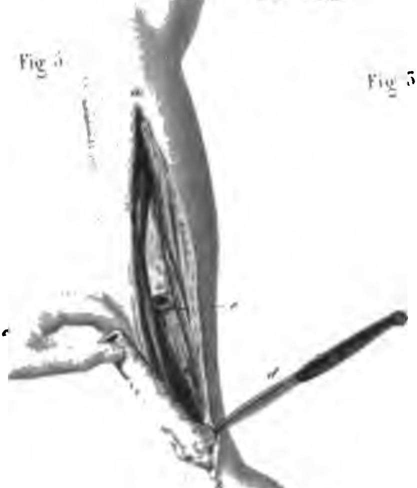

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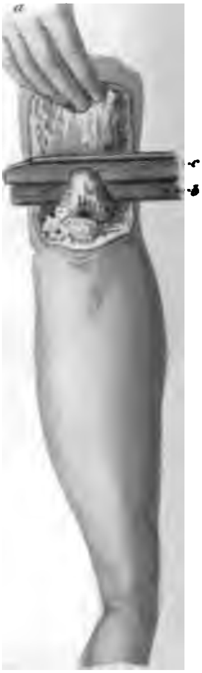

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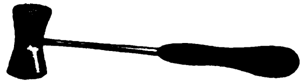
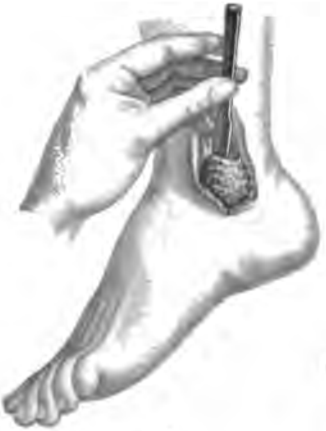
Fig 1.





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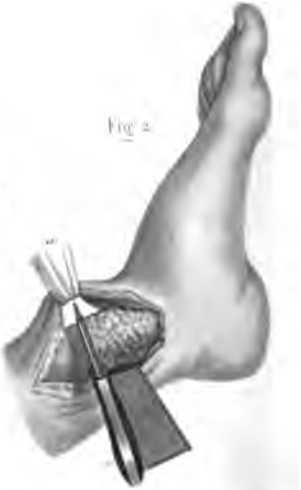

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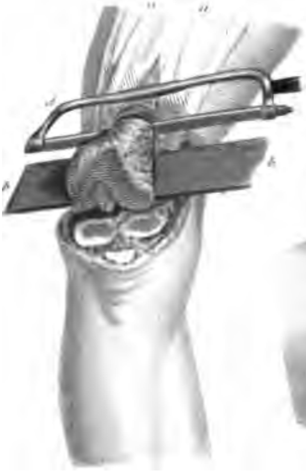

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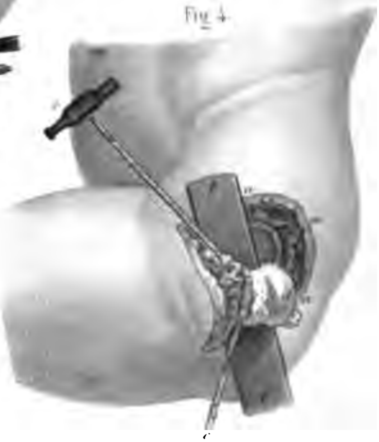
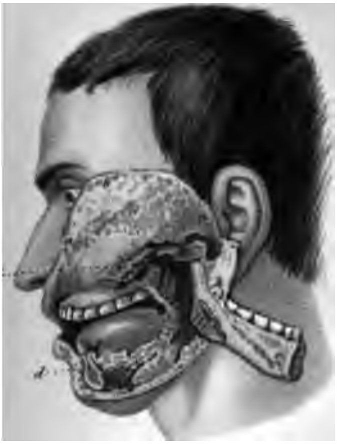


Pl. 34.

Fig. 1.



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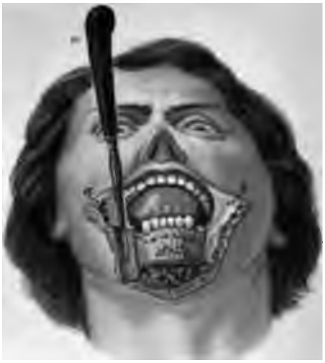

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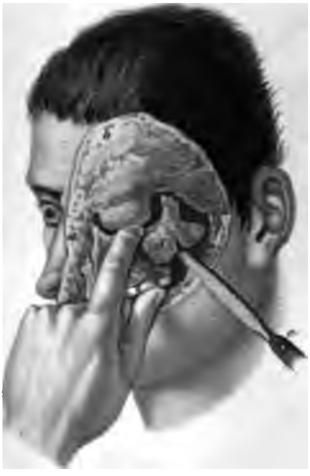

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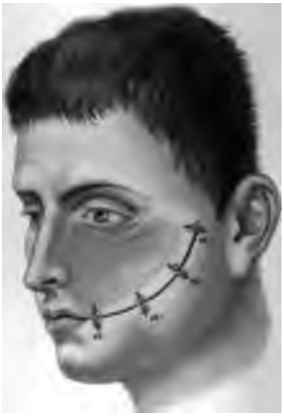

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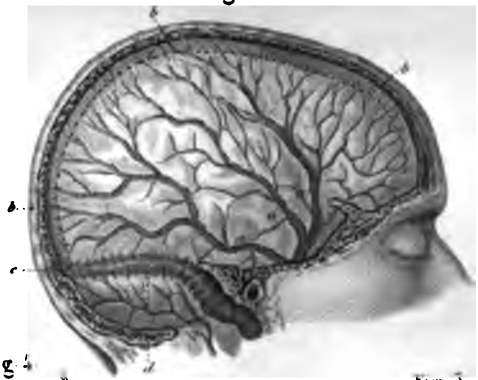

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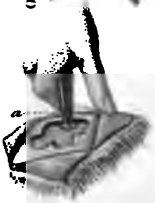

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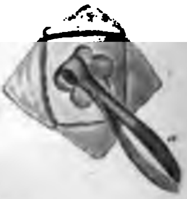

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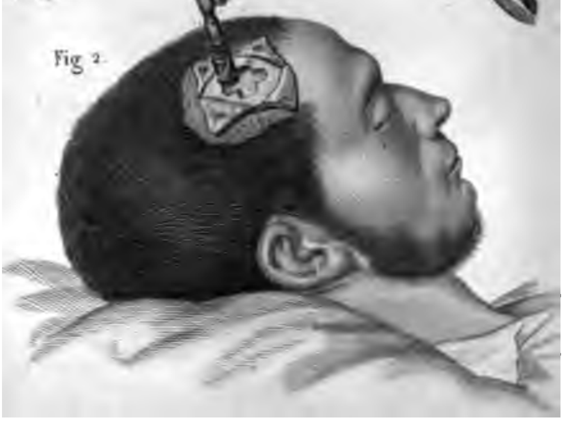

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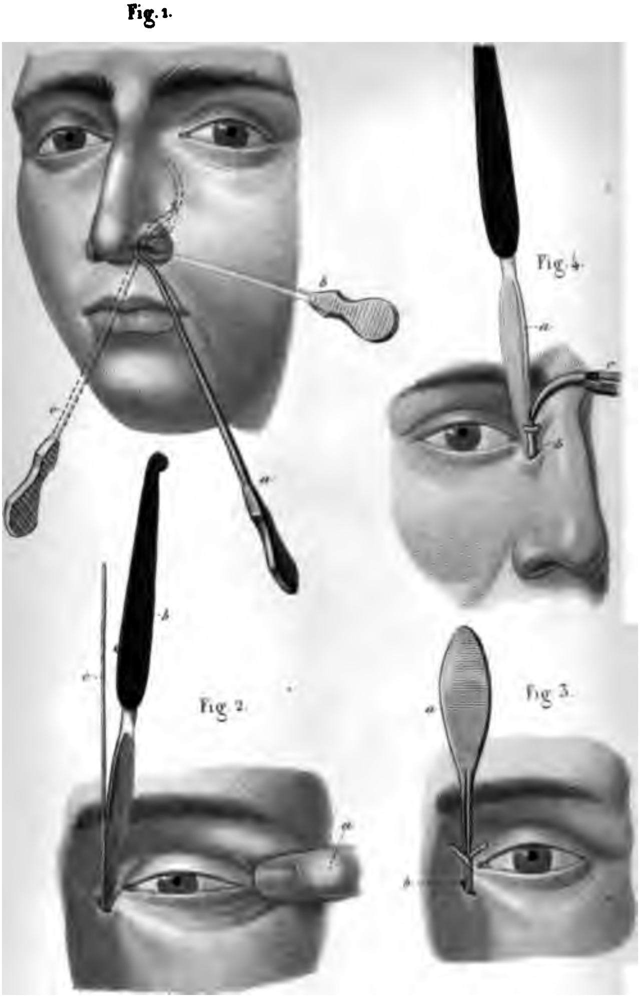
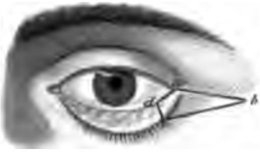


Pl. 37.

Fig. 1.



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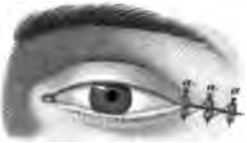

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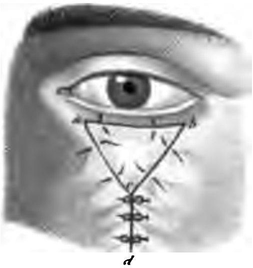

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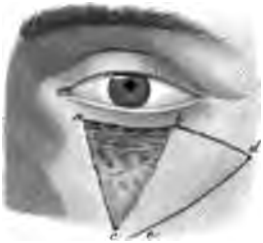

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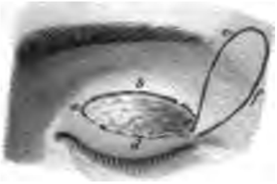

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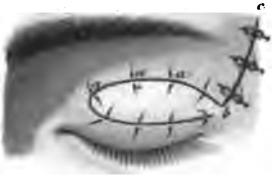

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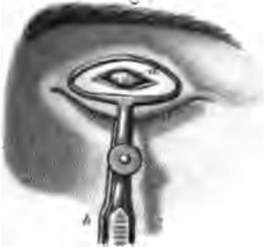

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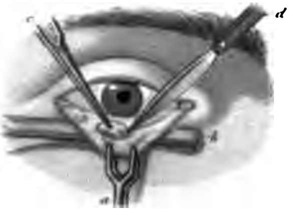

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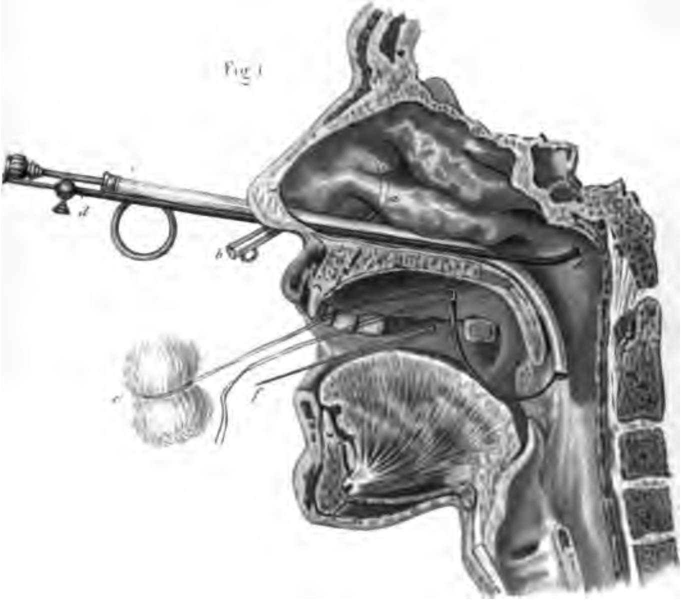
Fig 1



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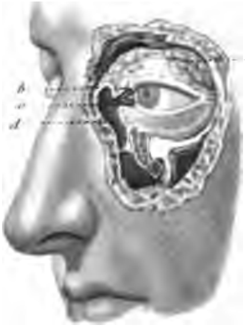

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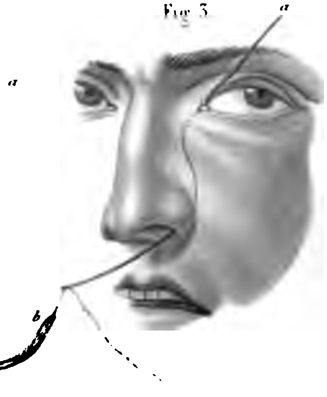
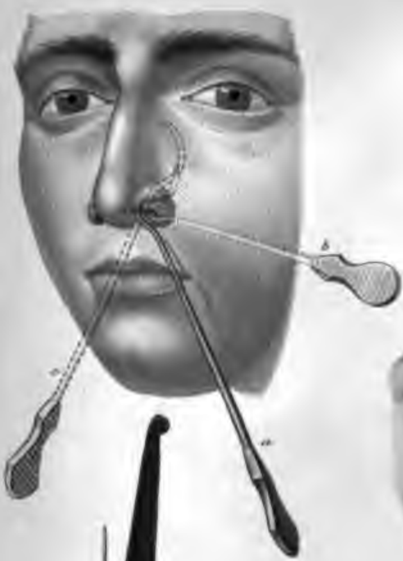


[illegible]

Pl. 39.

Fig. 1.



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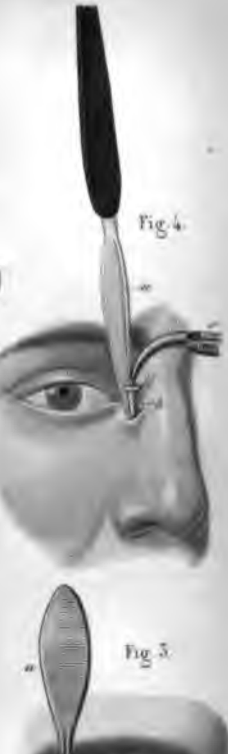

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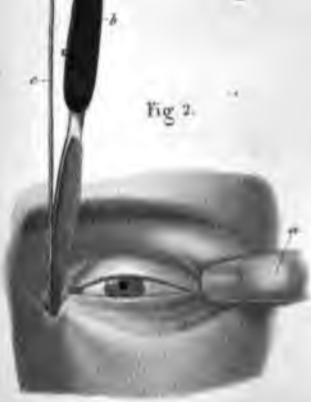

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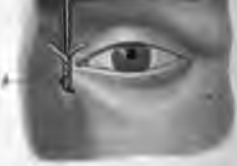
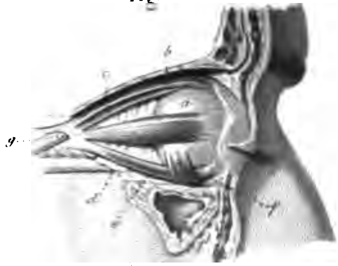


Pl. 40.

Fig. 1.



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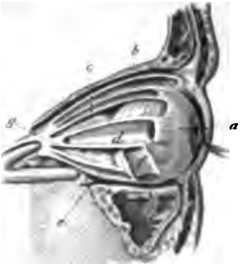

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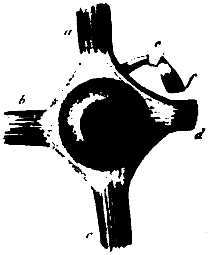

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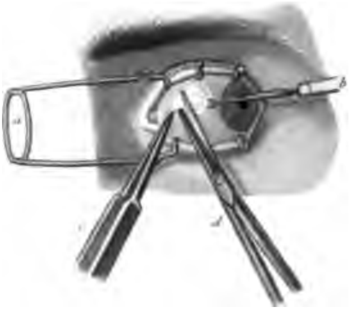
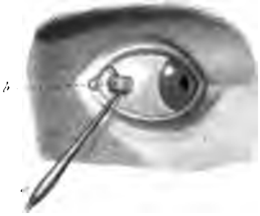


Fig. 5



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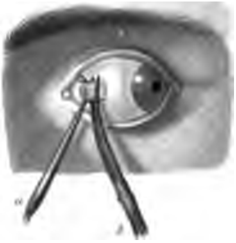
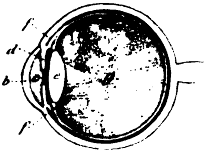


Pl. 41.

Fig. 1



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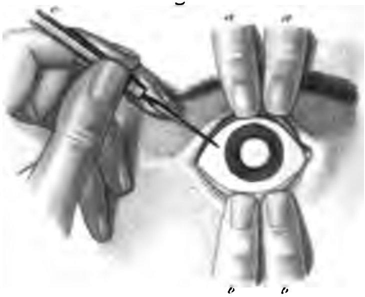
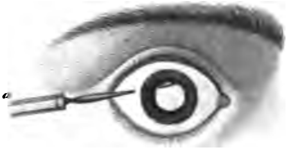


Fig. 3



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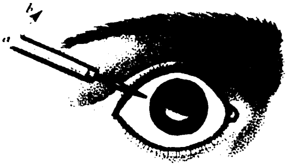

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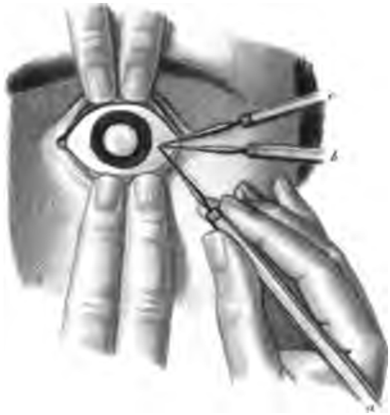

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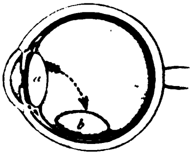


Pl. 42.

Fig. 1.

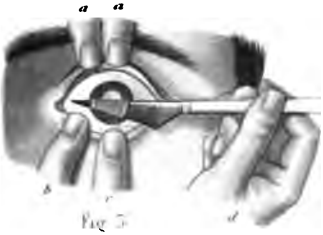


Fig. 2

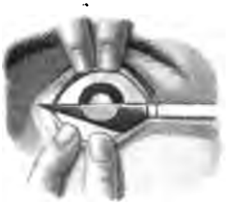


Fig. 3

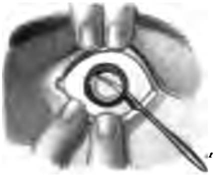
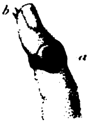


Fig. 5



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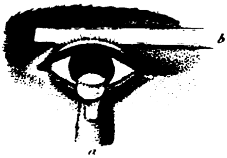


Fig. 6

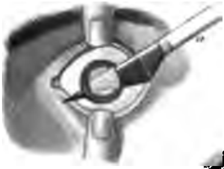
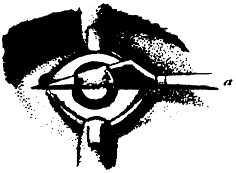


Fig. 7



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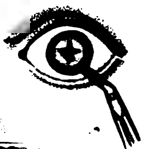


Fig. 8

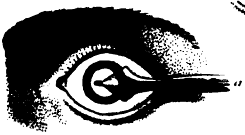
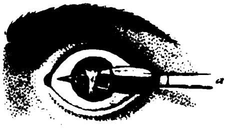


Fig. 12



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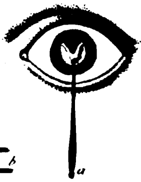

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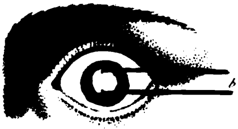

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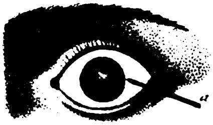

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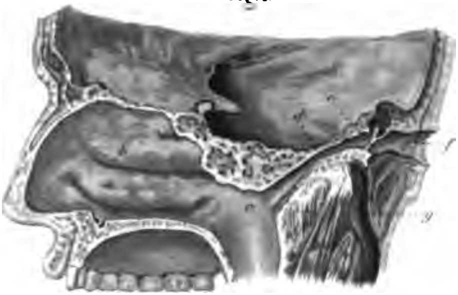

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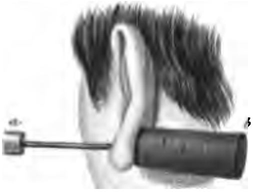

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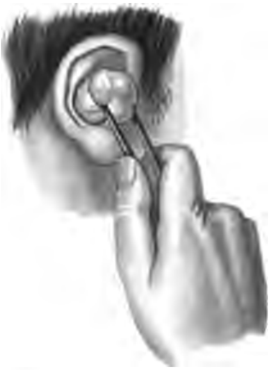

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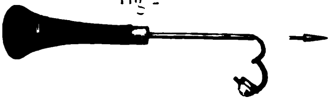

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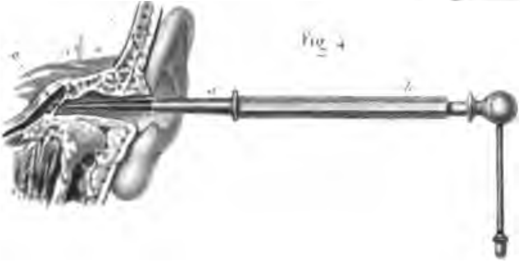

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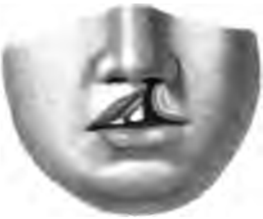

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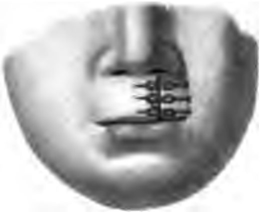

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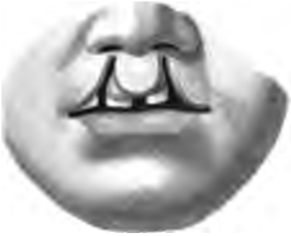

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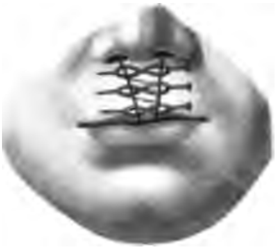

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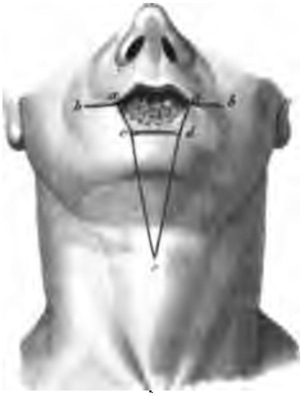

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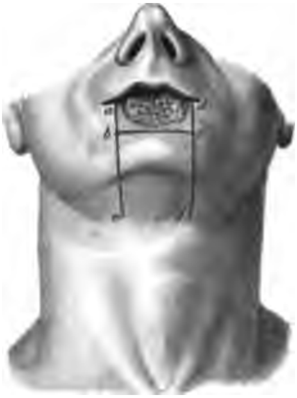

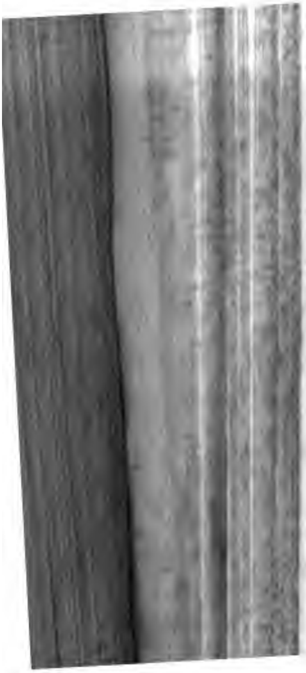

Pl. 48

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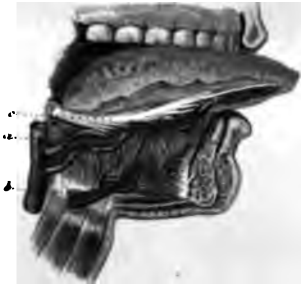

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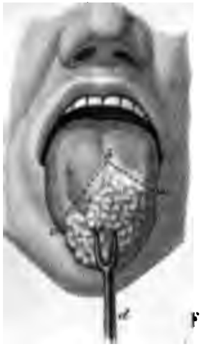

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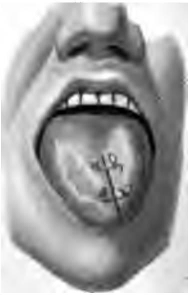

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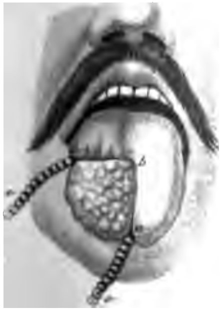

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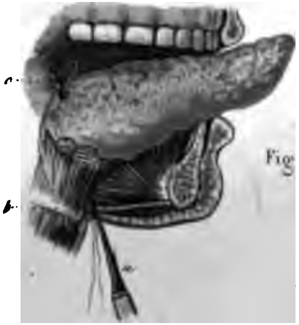

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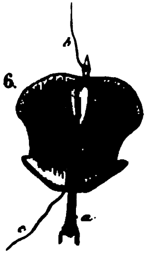

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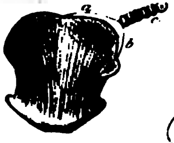

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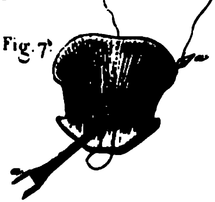

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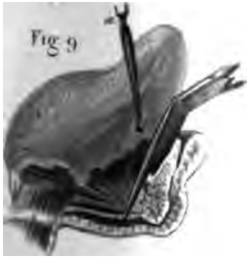

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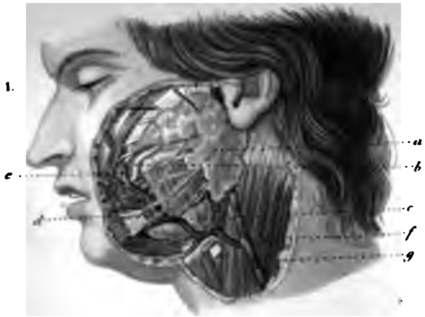

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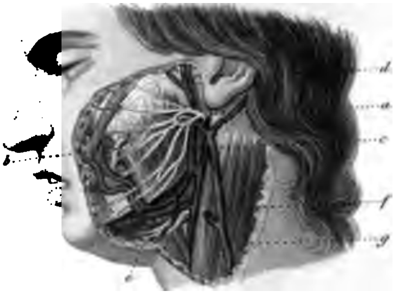

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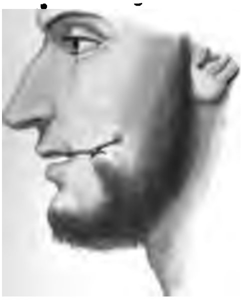

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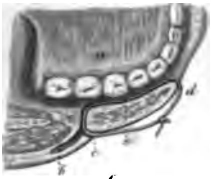

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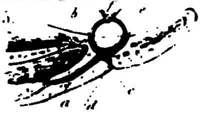
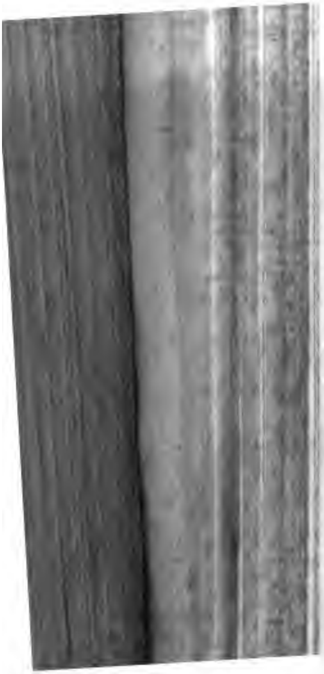
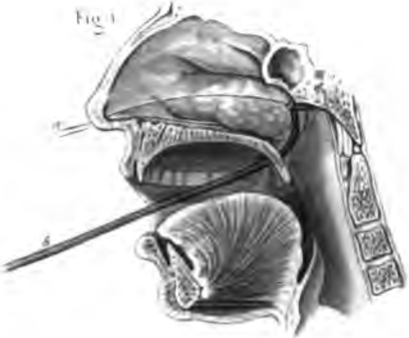




PL 47

Fig 1



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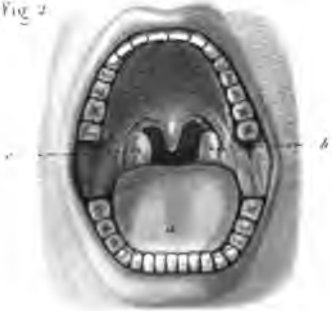

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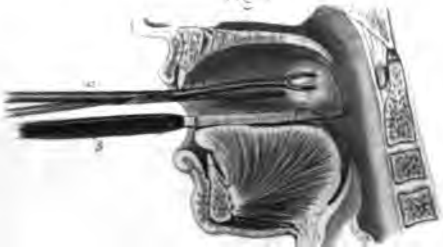

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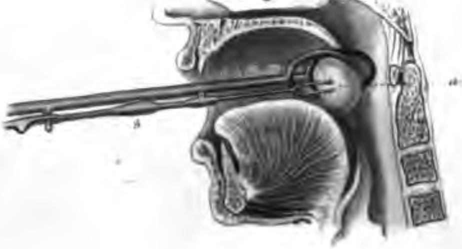

Pl. 48

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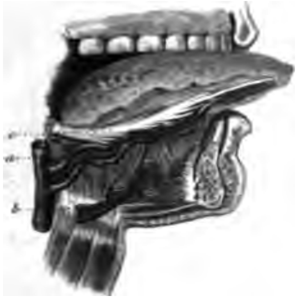

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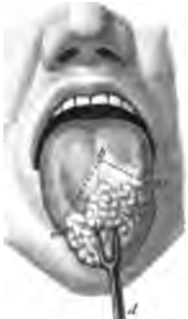

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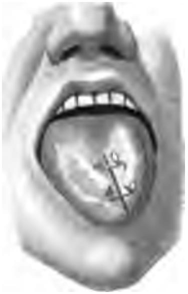

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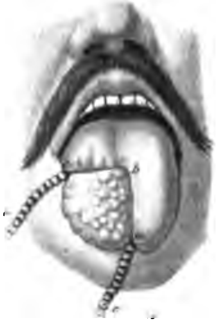

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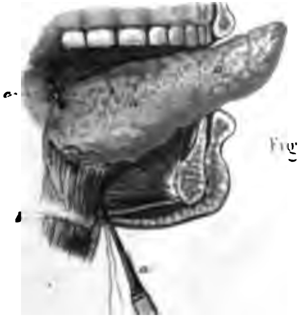

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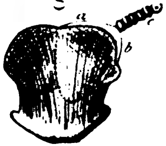

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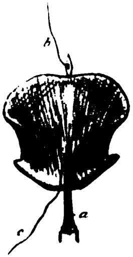

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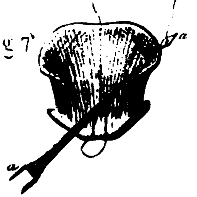

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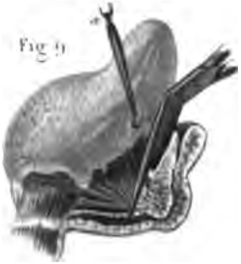

Pl. 49

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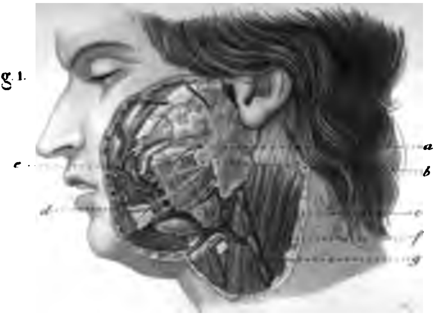

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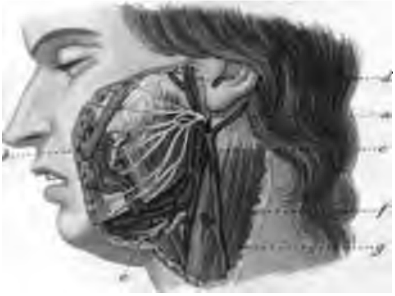

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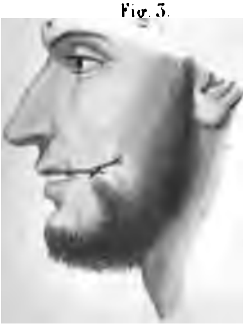

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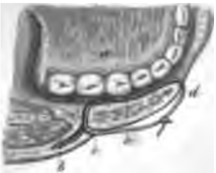

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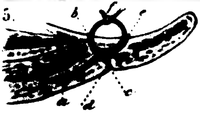
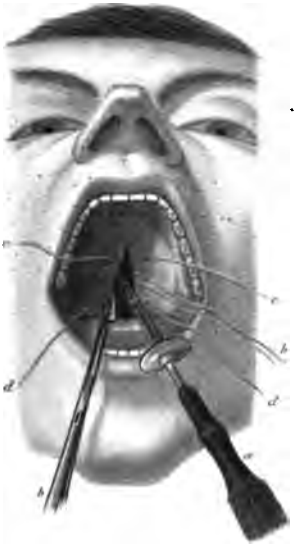


Pl. 50.

Fig. 1



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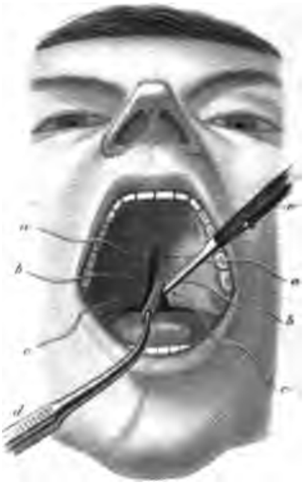

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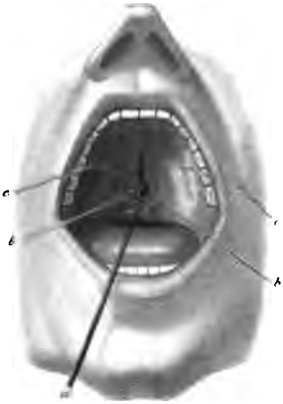

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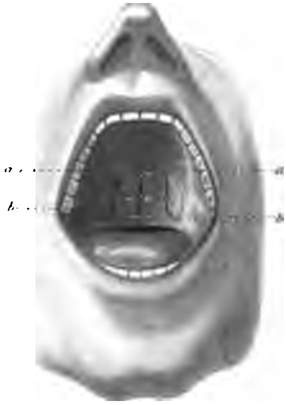

Pl. 31

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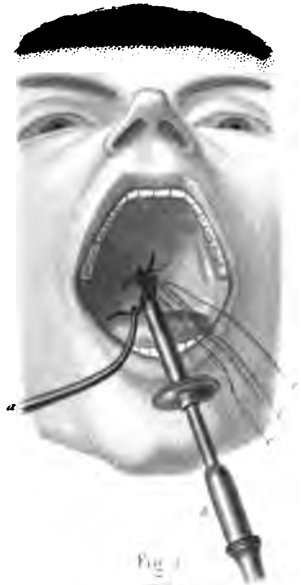

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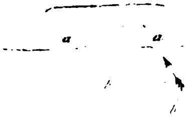
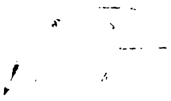


Fig. 4

Fig. 5



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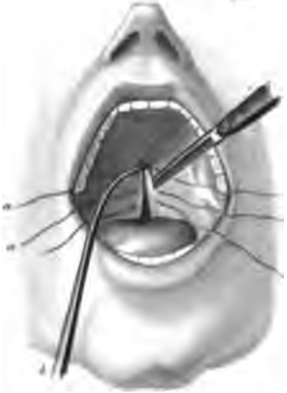

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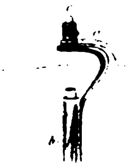

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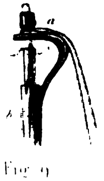

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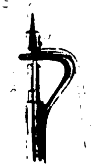

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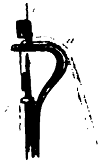

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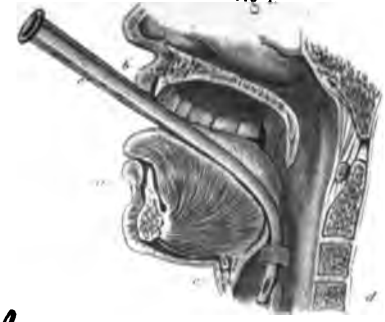

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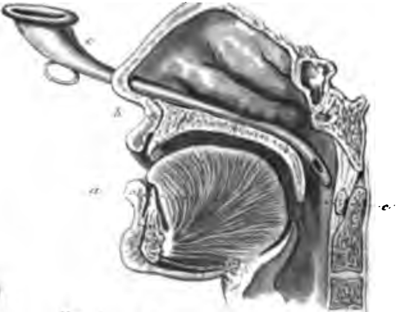

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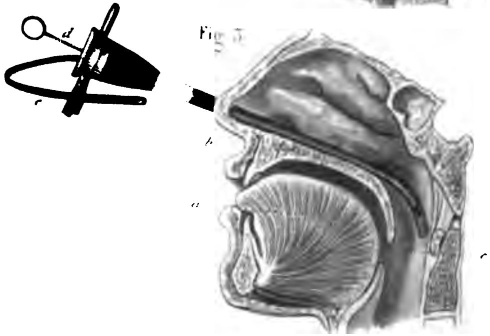

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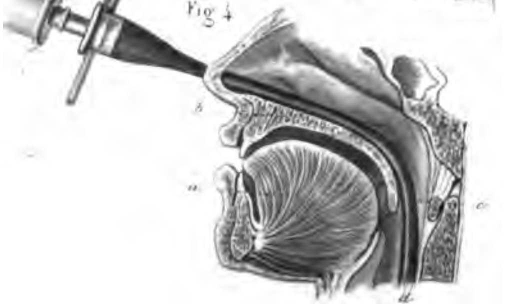


Pl 53

Fig 1.

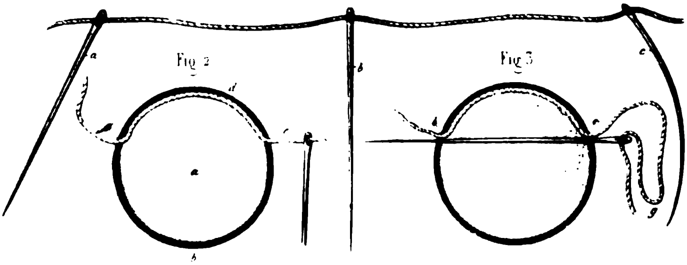
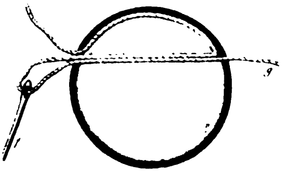


Fig 2

Fig 3

Fig 4



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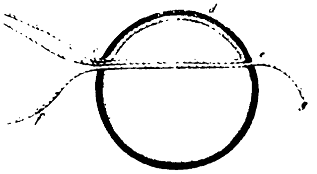

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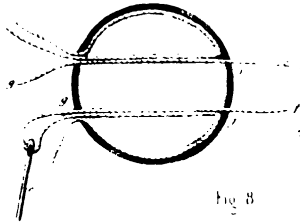

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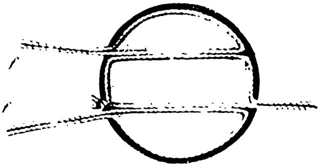

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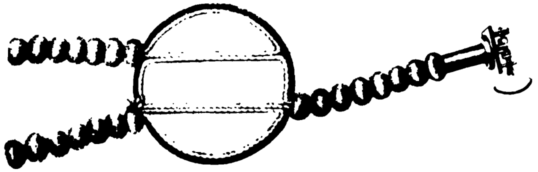


Pl. 54

Fig 1

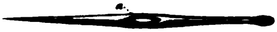
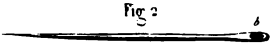


Fig 2



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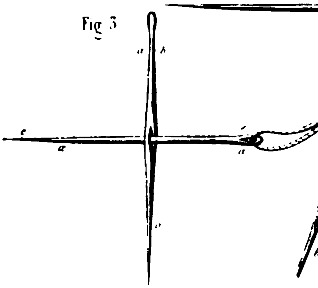

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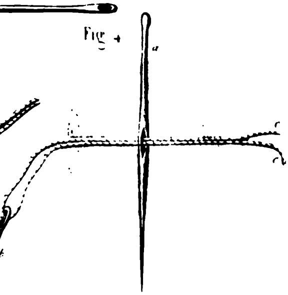

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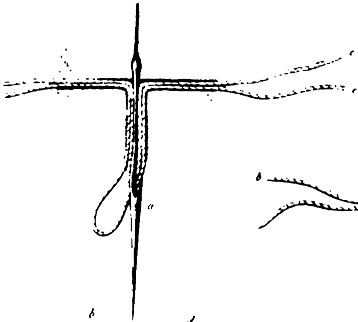

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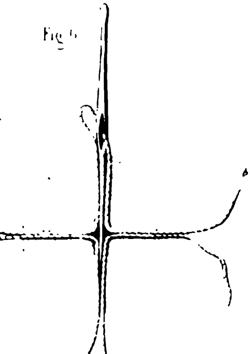

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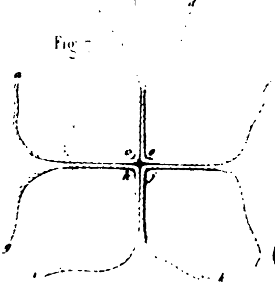

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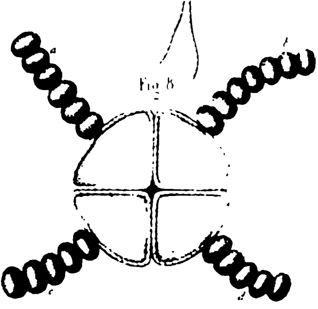

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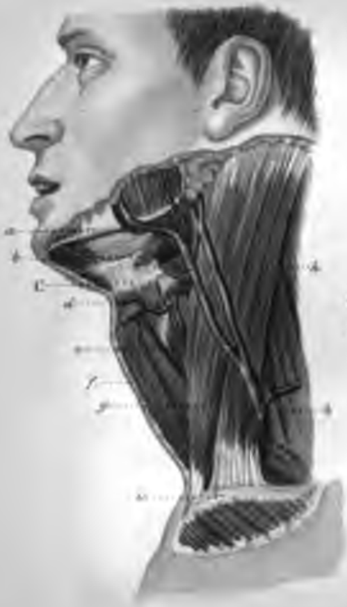

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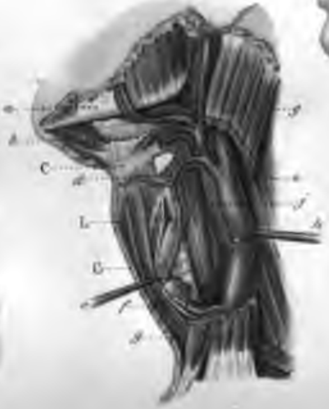

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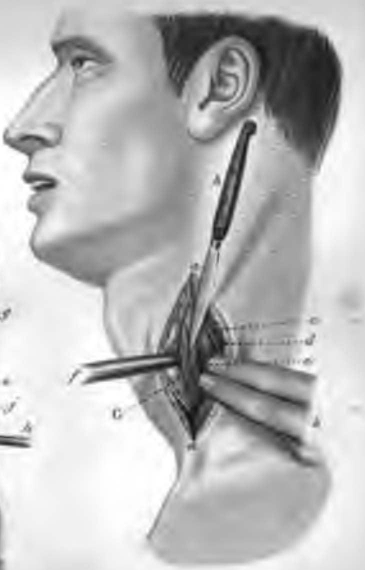

Pl. 56

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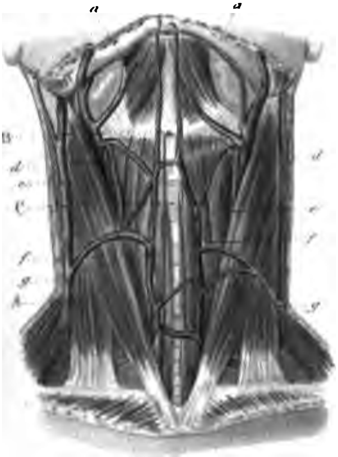

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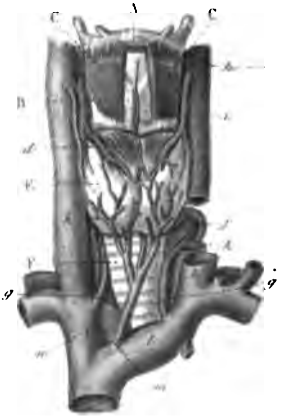

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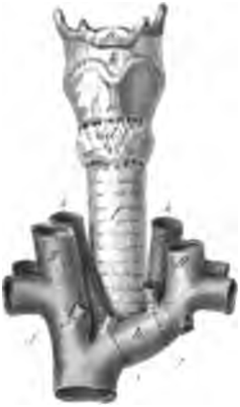

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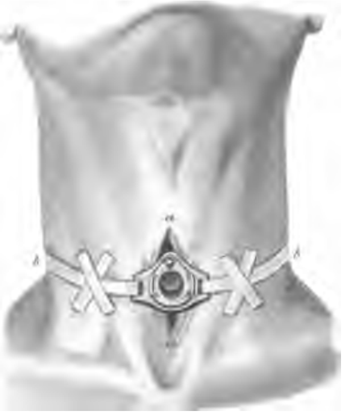
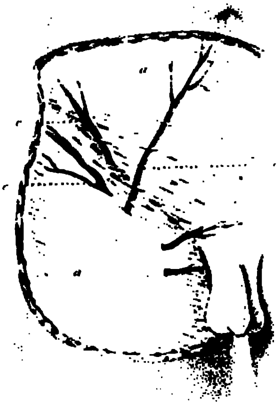


Pl. 60

Fig. 1



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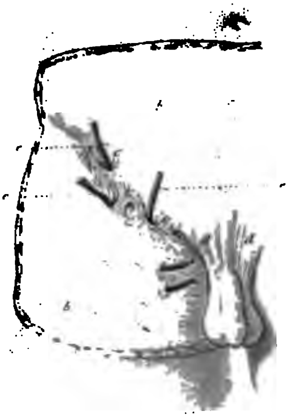

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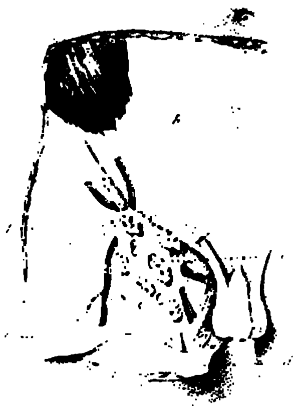

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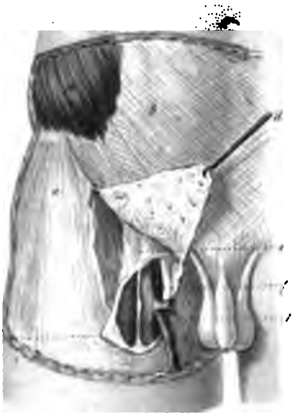
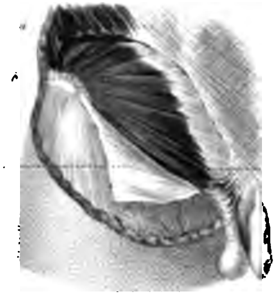


Pl. 61

Fig 1



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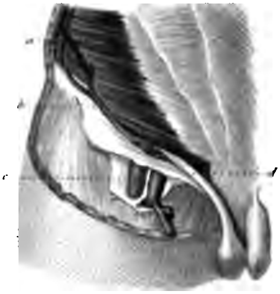

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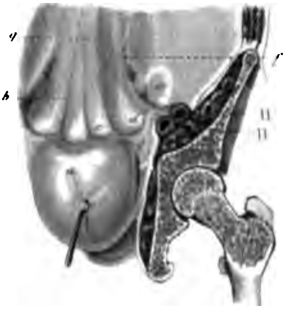

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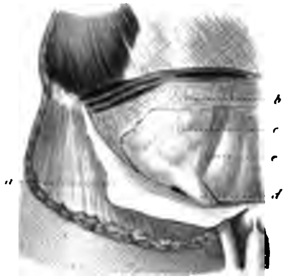

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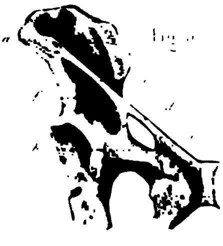

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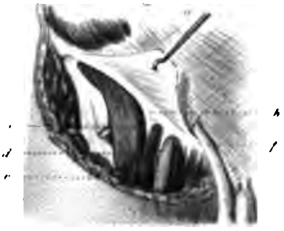

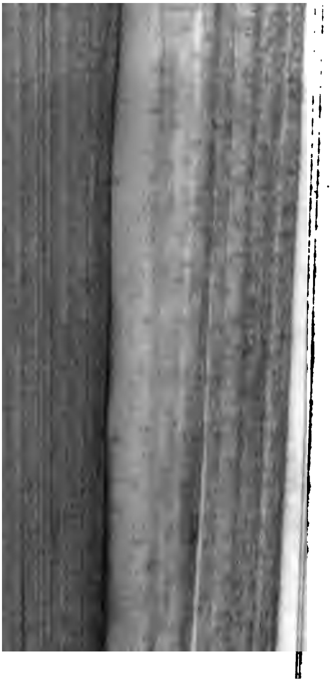

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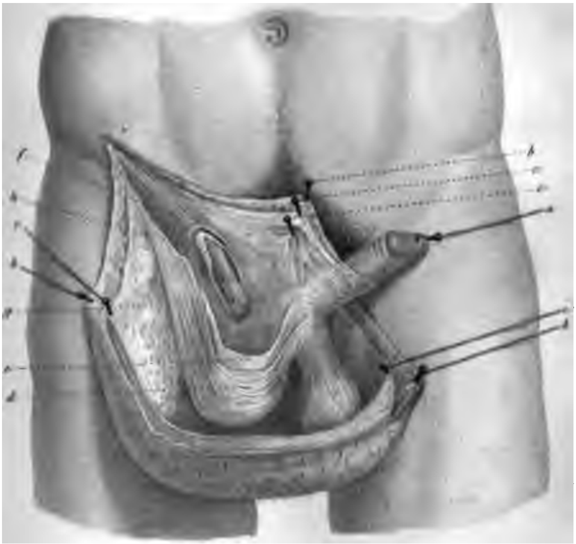

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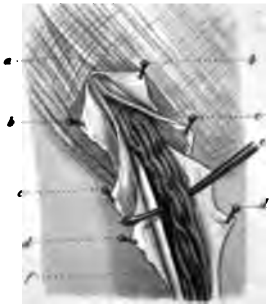

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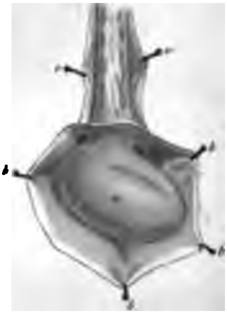

Pl. 60

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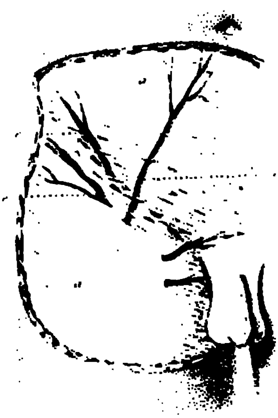

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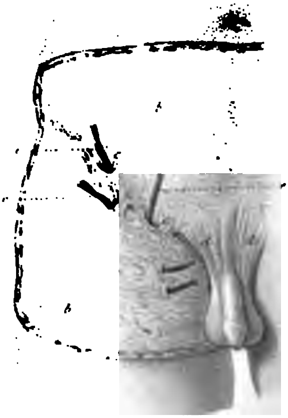

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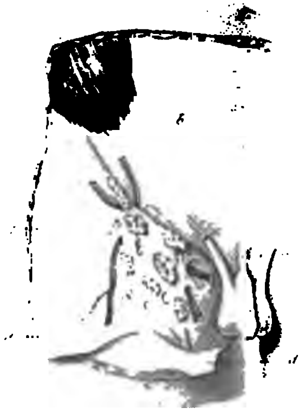

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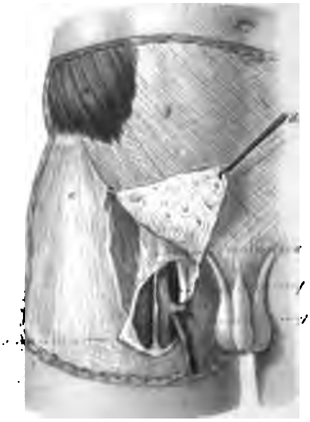

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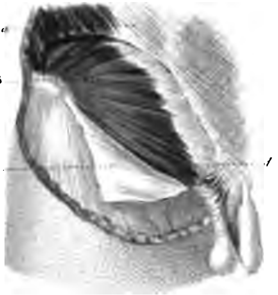

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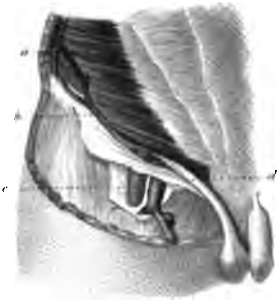

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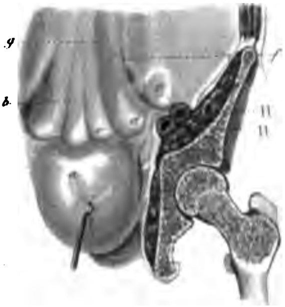

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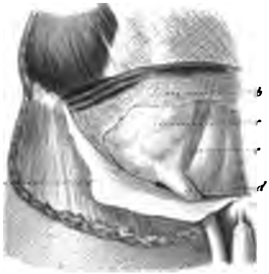

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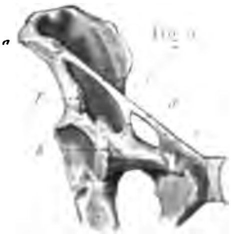

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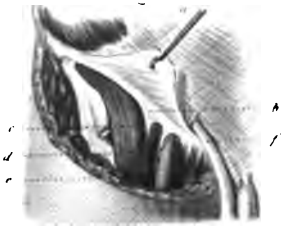
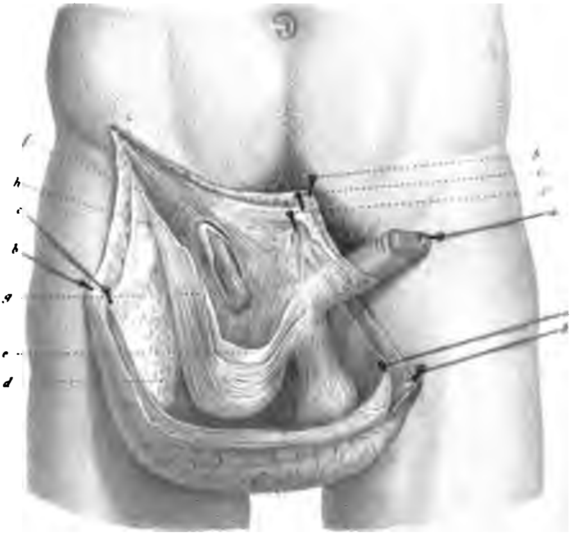


Pl. 62

Fig. 1



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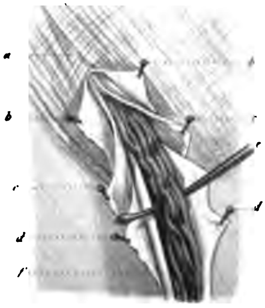
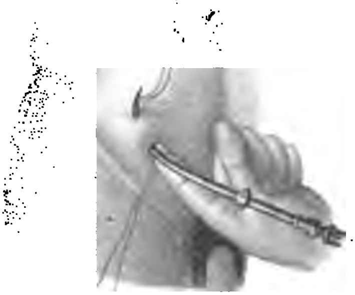


Fig. 3

Pl. 65

Fig 1



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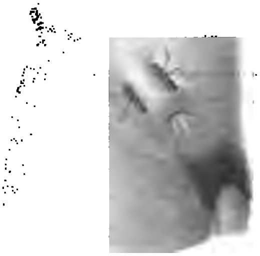

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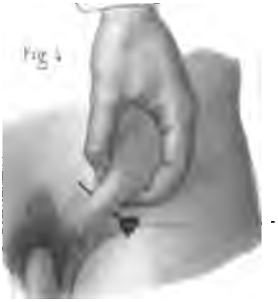
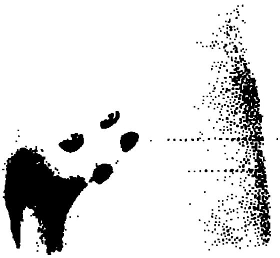
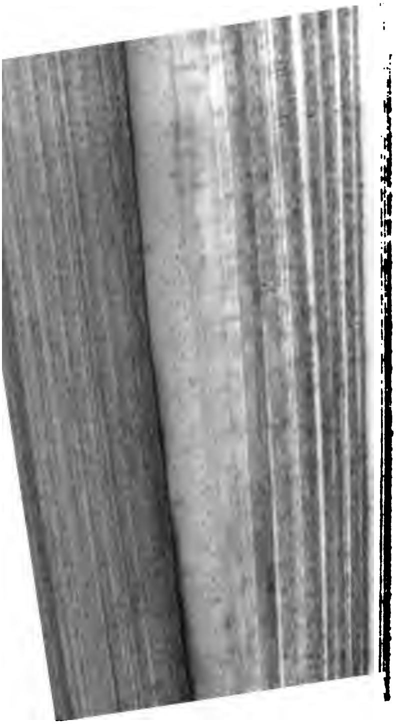
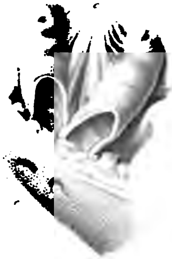






Pl. 67

Fig 1.



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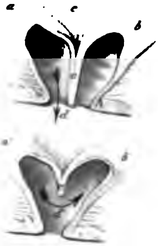

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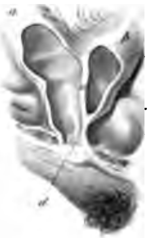

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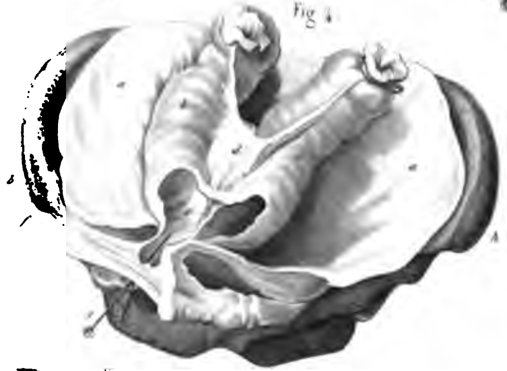

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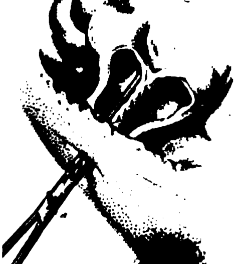

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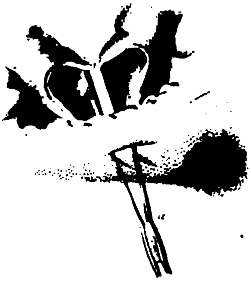
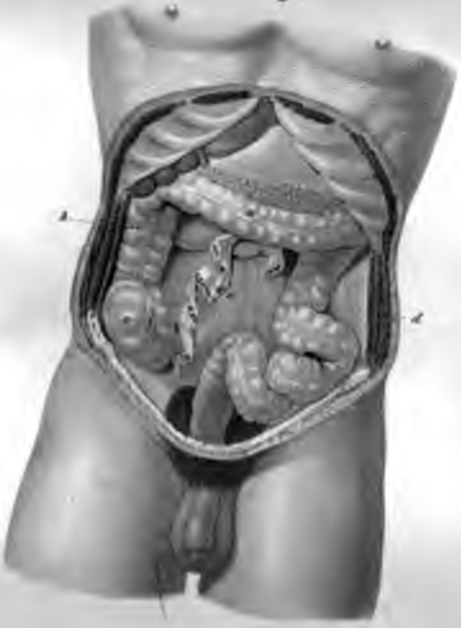


Pl. 88

Fig. 1



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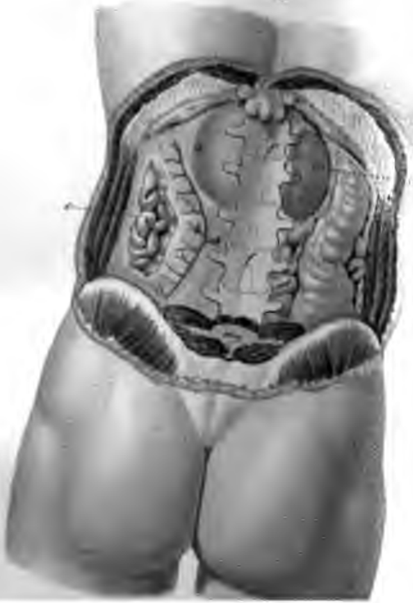
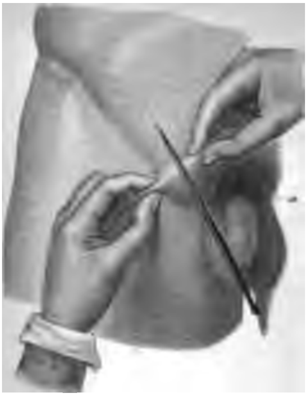


PL 66

Fig. 1.



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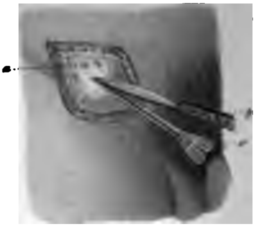

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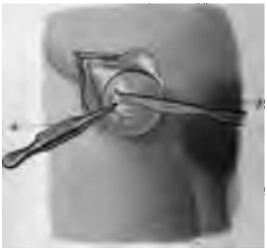

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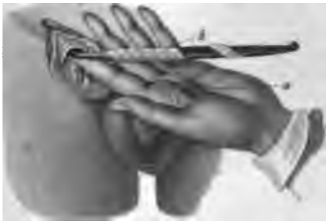

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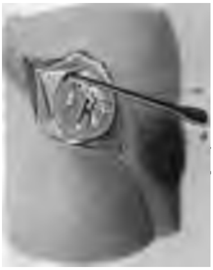

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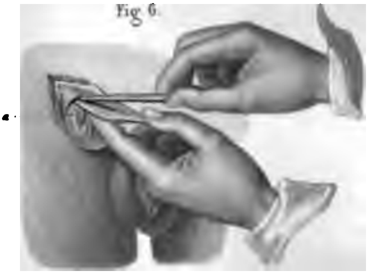

Pl. 67

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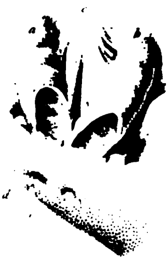

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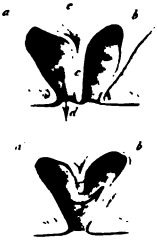

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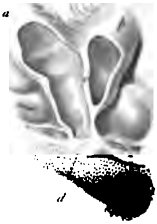

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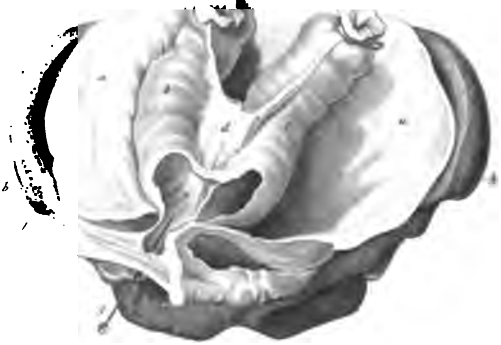

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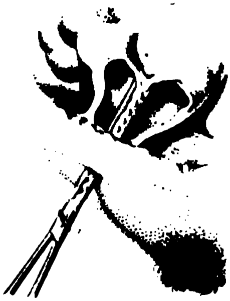

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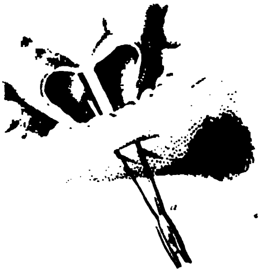
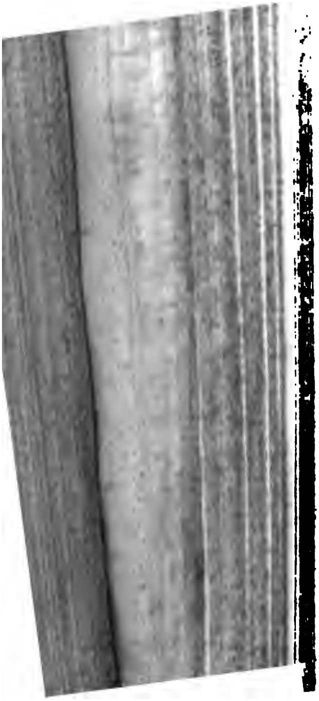
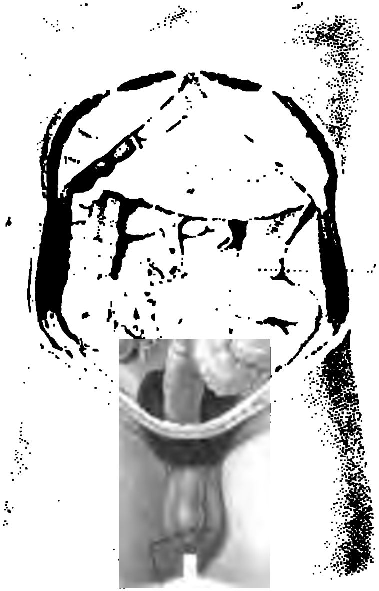




Pl. 68

Fig. 1



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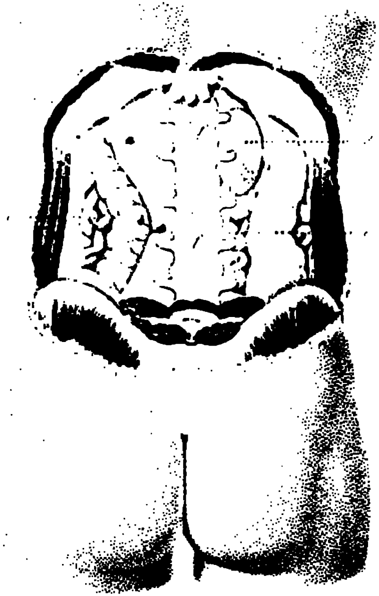

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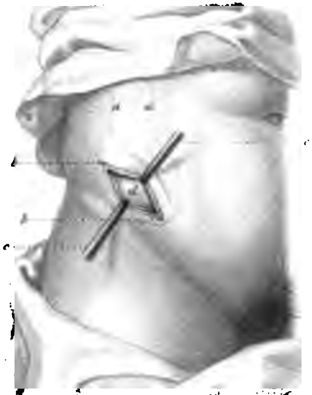

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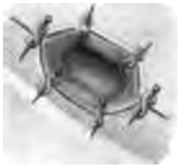

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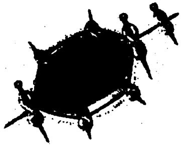

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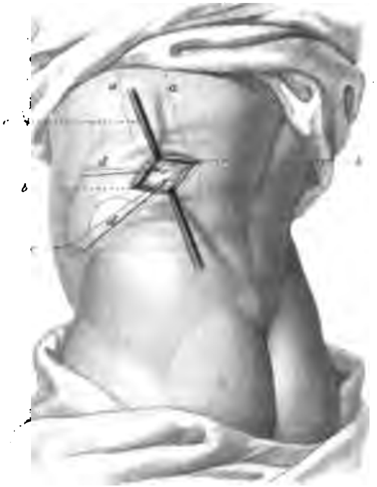


Pl. 73

Fig 1

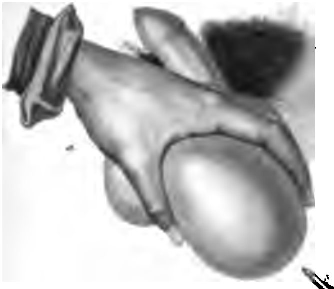


Fig 2

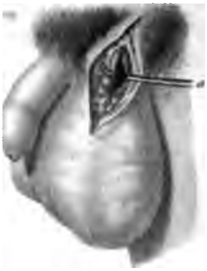
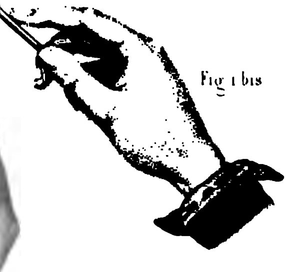


Fig 1 bis



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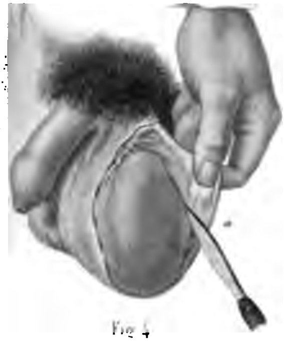

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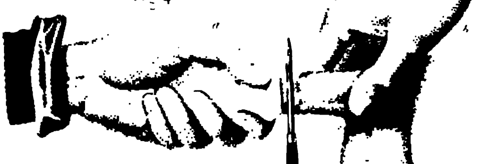
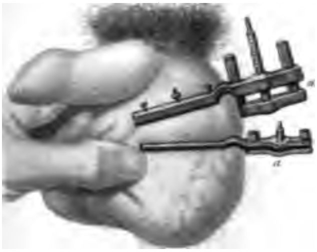


PL. 74

Fig 1.



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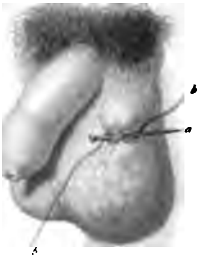

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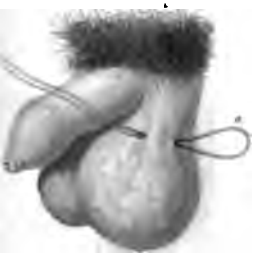

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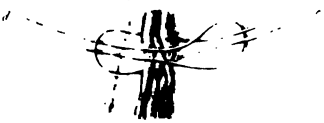

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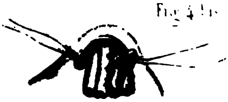

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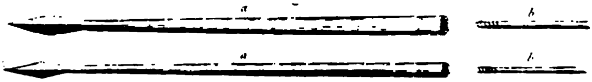


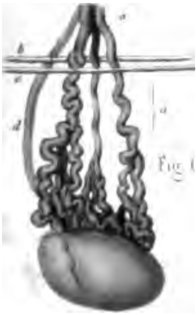
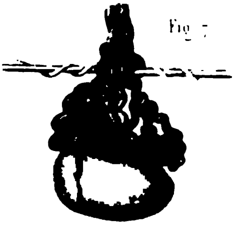


Fig 6

Fig 7



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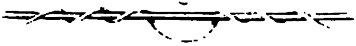

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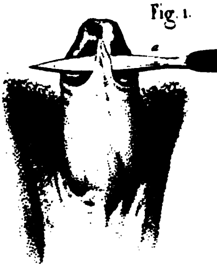
Pl. 72

Fig. 1.



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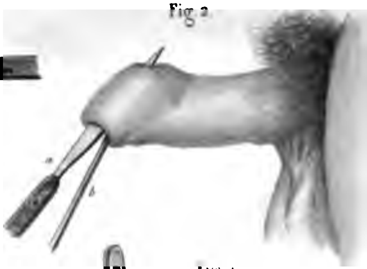

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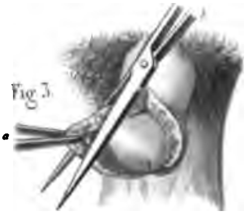

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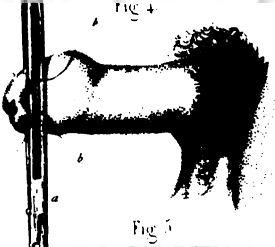

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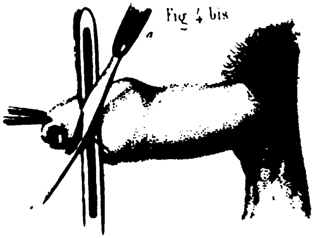

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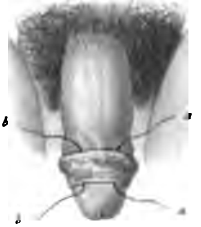

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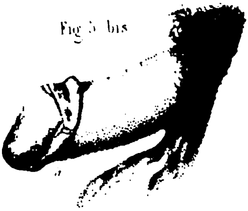

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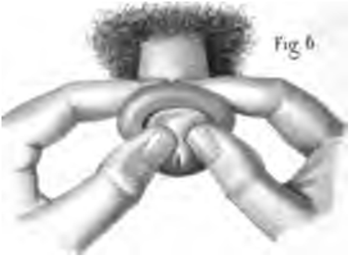
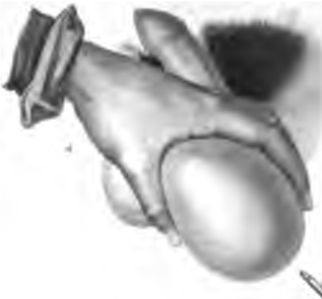


Pl. 73

Fig 1



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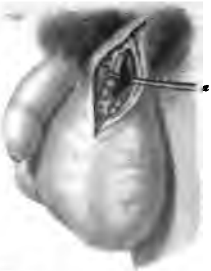

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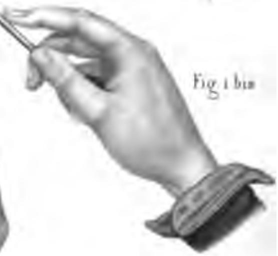

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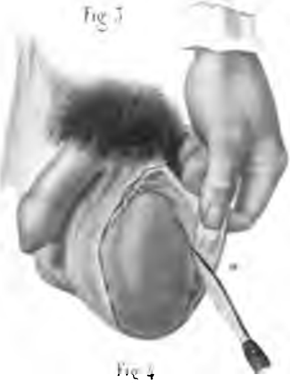

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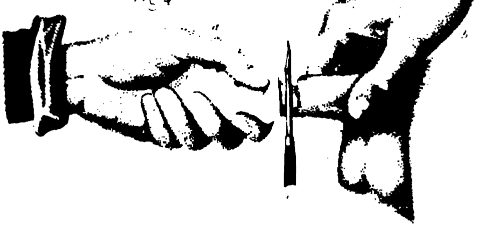
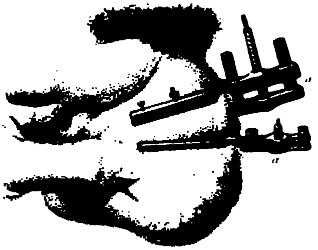


Pl. 74

Fig 1



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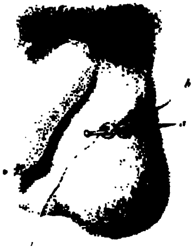

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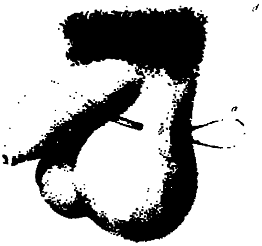

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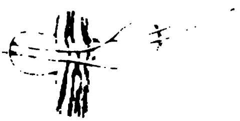

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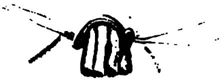

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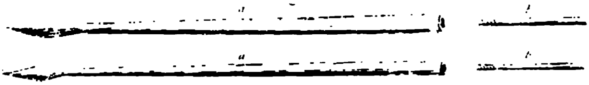

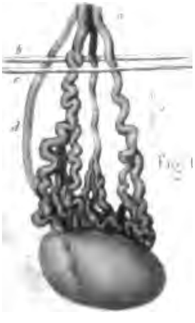

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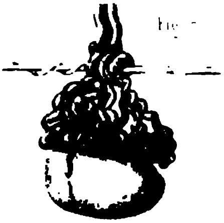
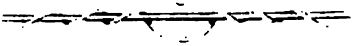


Fig. 7

Fig. 8.



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Pl. 78

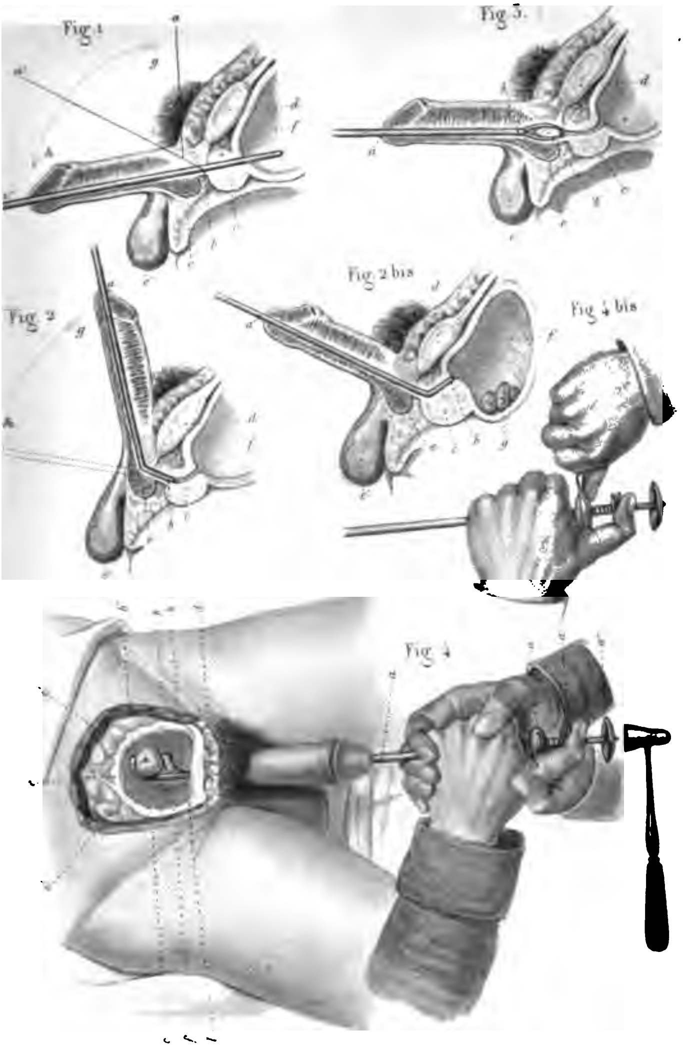

Fig. 1
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Fig. 4
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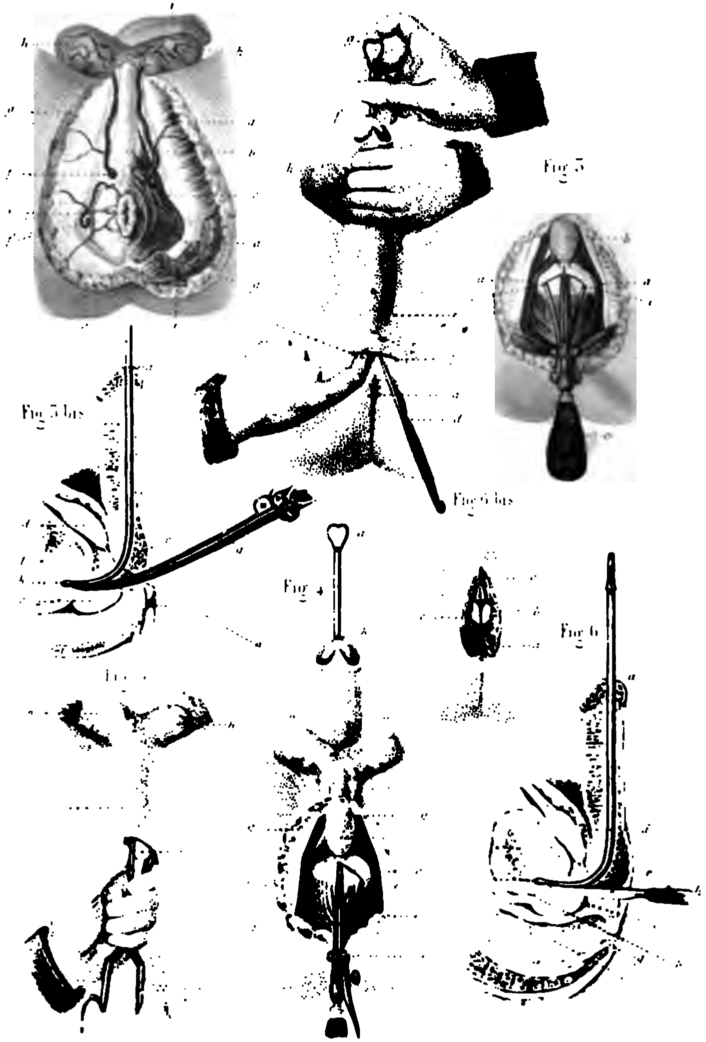
Pl. 79



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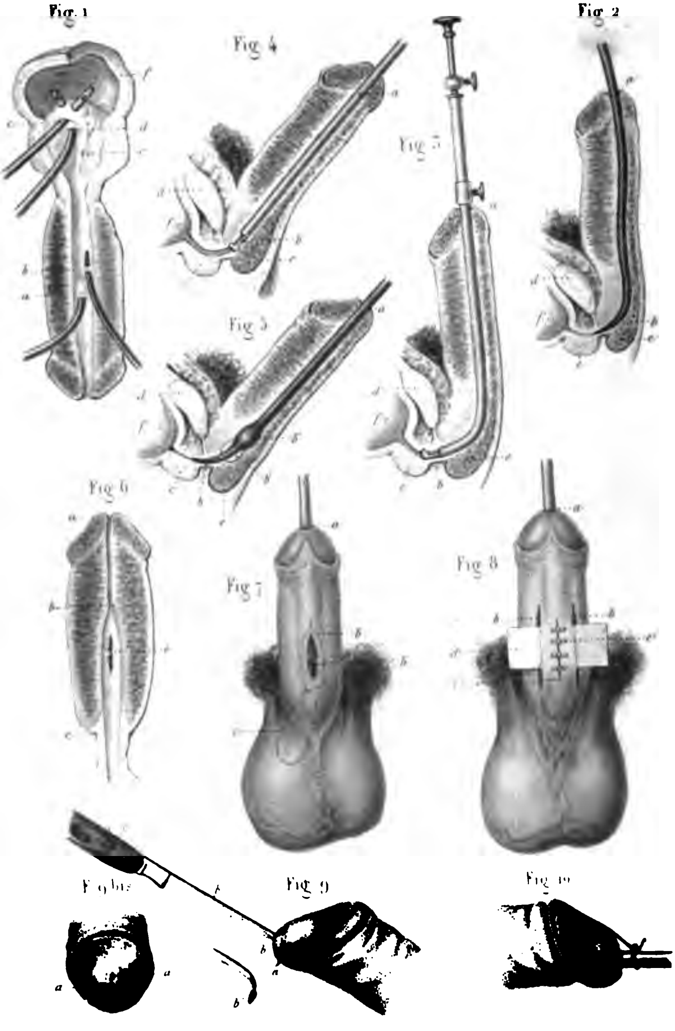

Leveillé del

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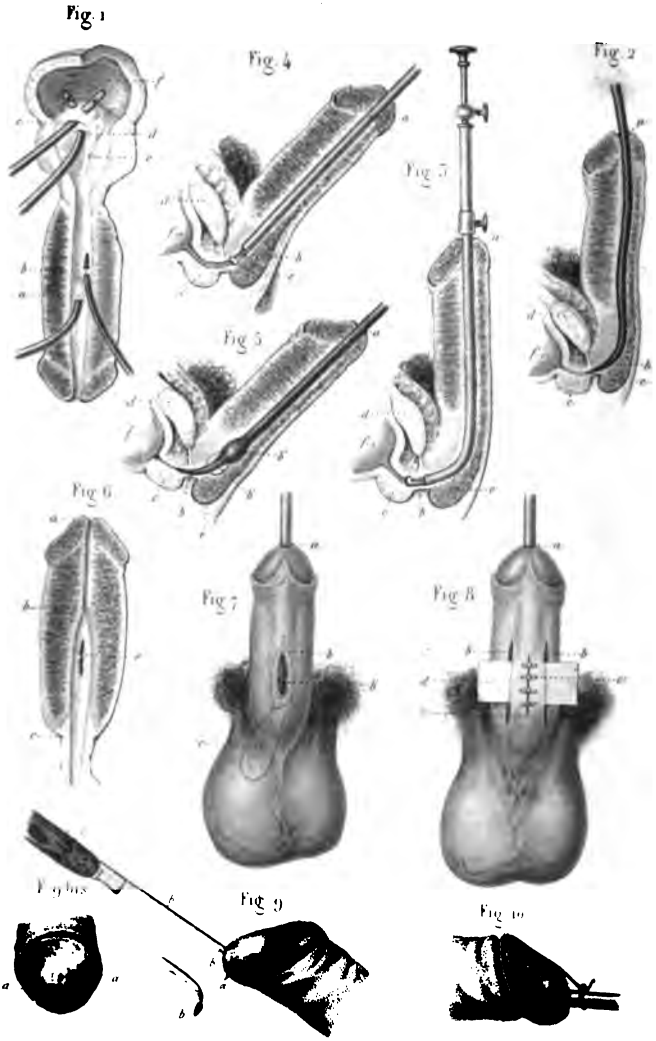
Paris

Pl. 77



Leveillé del.

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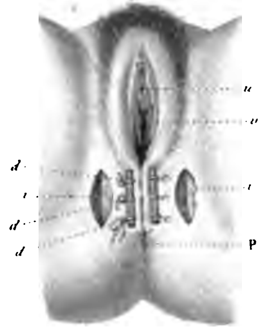
Pl. 82

Fig 1



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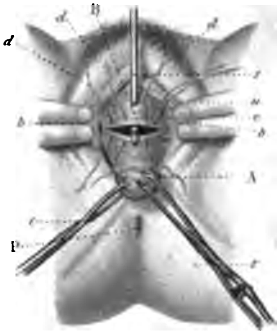

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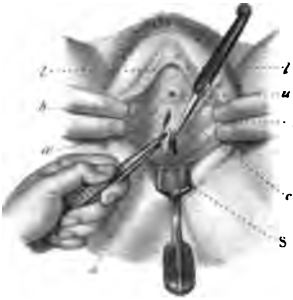

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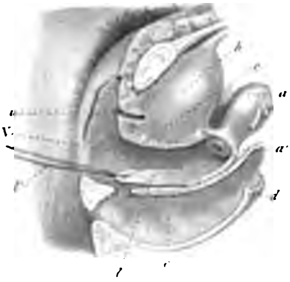

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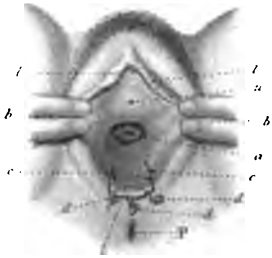

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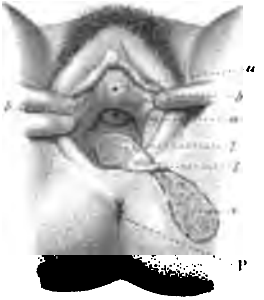
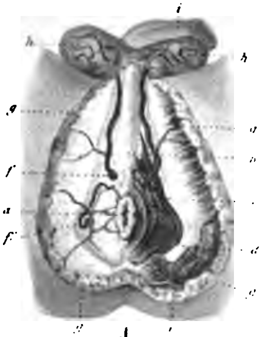


Pl. 79

Fig 1.



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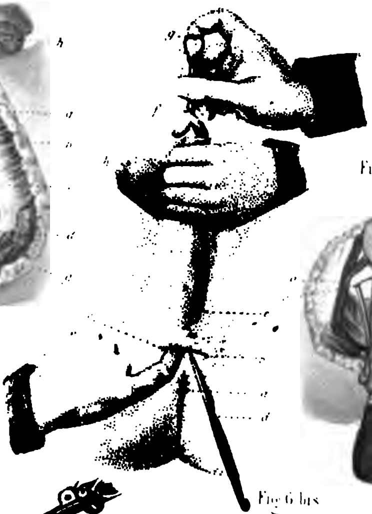

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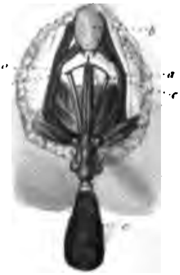

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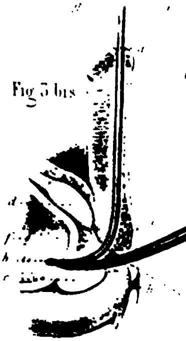

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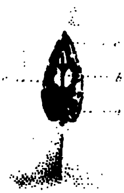

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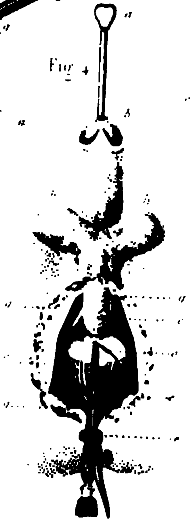

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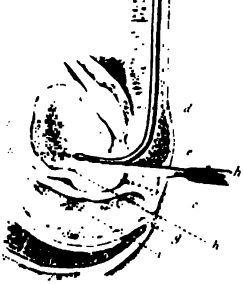

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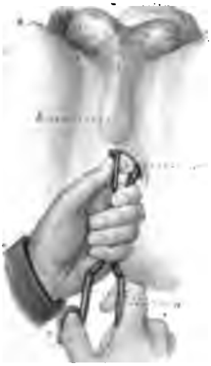

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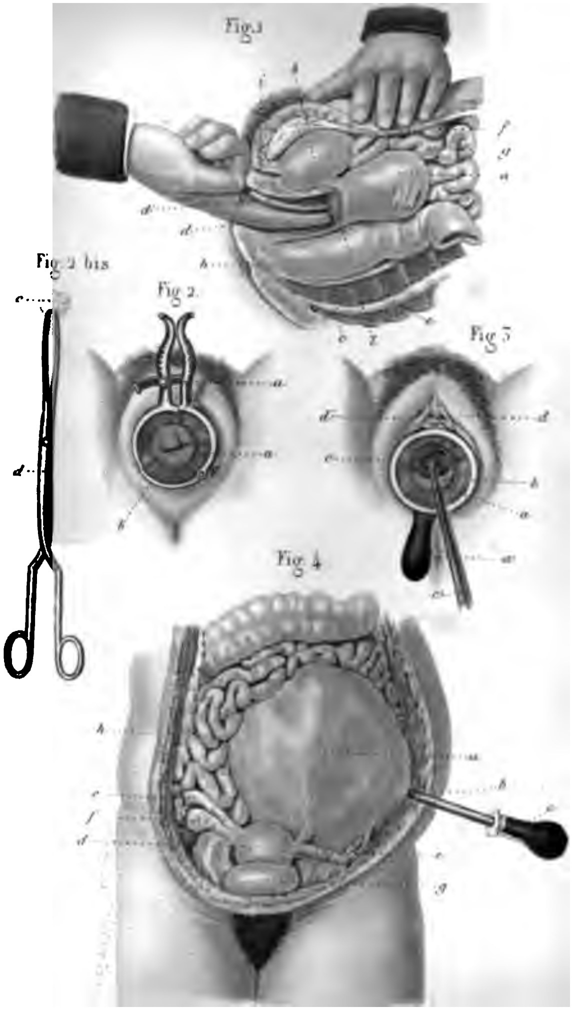
Pl. 84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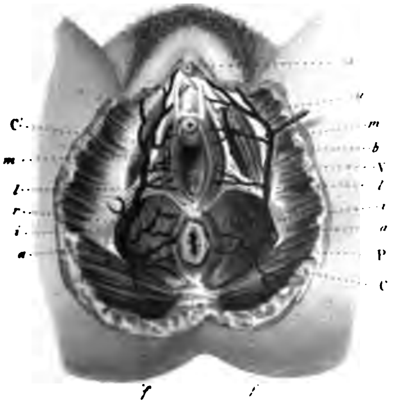
PL. 81

Fig 1



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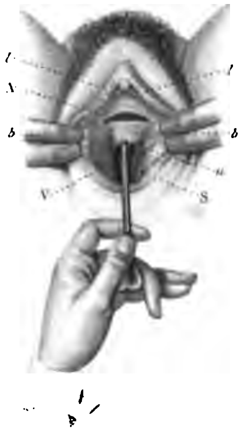

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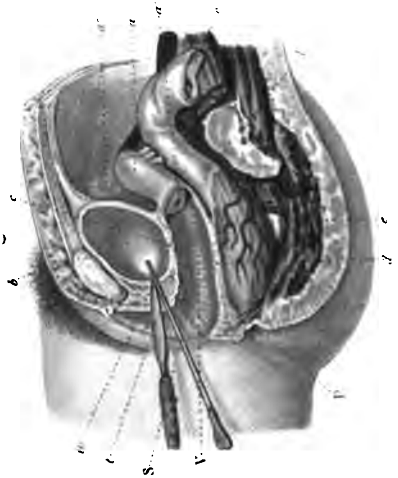
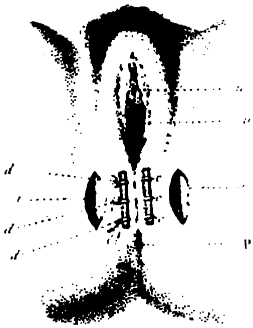


Pl. 82

Fig 1



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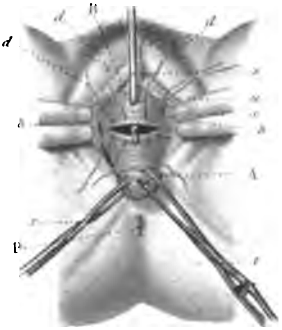

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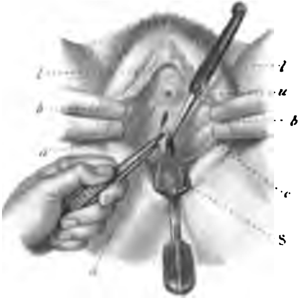

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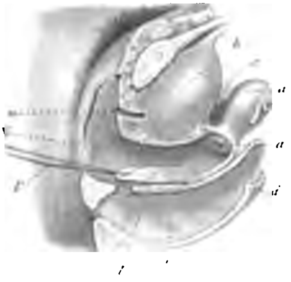

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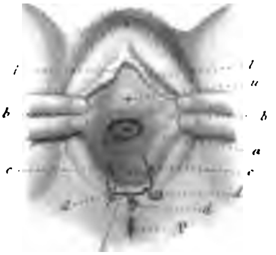

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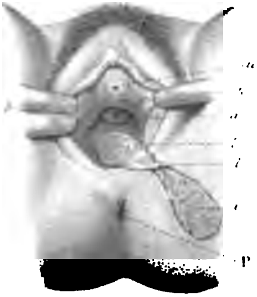
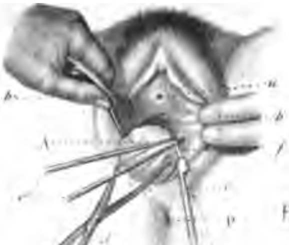


Pl. 83.

Fig. 1



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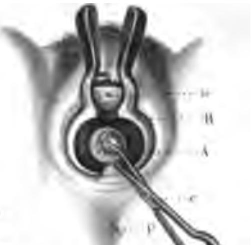

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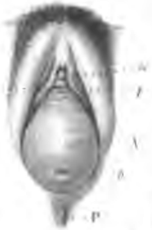

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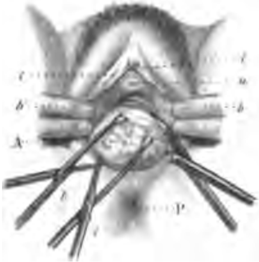

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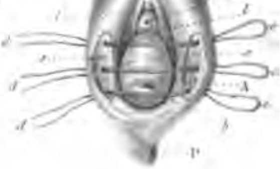

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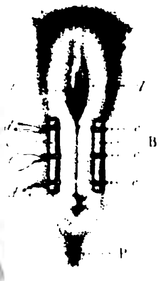

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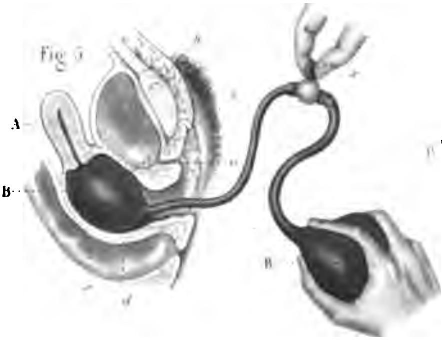
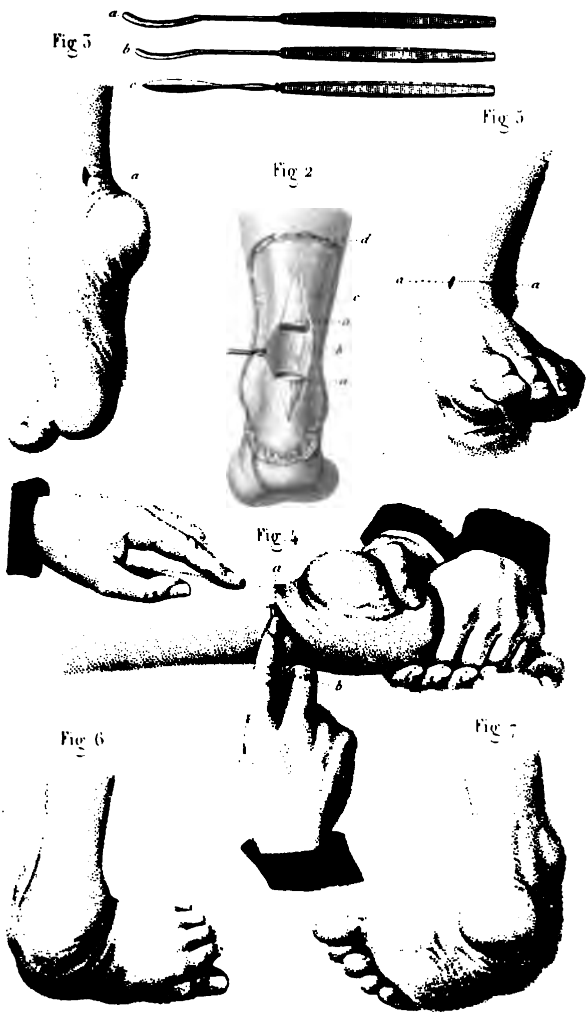


Pl. 88



Pl. 85

Fig. 1 bis

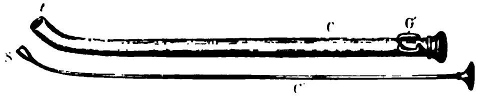


Fig. 1

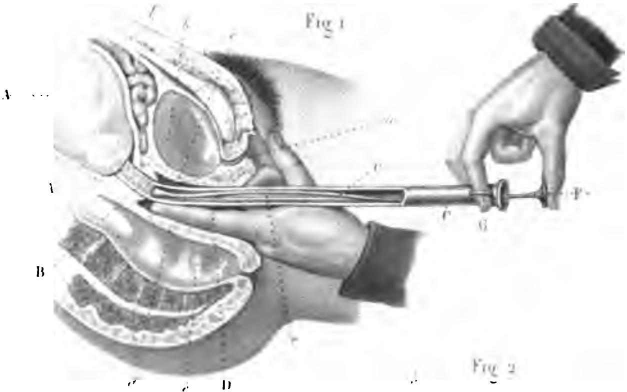


Fig. 2

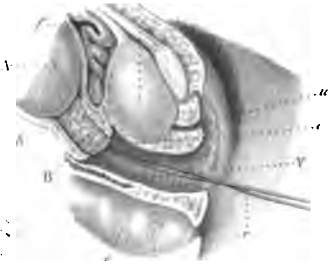


Fig. 3